In cooperation with the Houston-Galveston Area Council and the Texas Commission on Environmental Quality

Hydrologic, Water-Quality, and Biological Data for Three Water Bodies, Texas Gulf Coastal Plain, 2000–2002

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Hydrologic, Water-Quality, and Biological Data for Three Water Bodies, Texas Gulf Coastal Plain, 2000–2002

By Jeffery W. East and Jennifer L. Hogan

U.S. GEOLOGICAL SURVEY
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Hydrologic, Water-Quality, and Biological Data for Three Water Bodies, Texas Gulf Coastal Plain, 2000–2002

By Jeffery W. East *and* Jennifer L. Hogan

Abstract

During July 2000–September 2002, the U.S. Geological Survey collected and analyzed site-specific hydrologic, water-quality, and biological data in Dickinson Bayou, Armand Bayou, and the San Bernard River in the Gulf Coastal Plain of Texas. Segments of the three water bodies are on the State 303(d) list. Continuous monitoring showed that seasonal variations in water temperature, specific conductance, pH, and dissolved oxygen in all three water bodies were similar to those observed at U.S. Geological Survey stations along the Texas Gulf Coast. In particular, water temperature and dissolved oxygen are inversely related. Periods of smallest dissolved oxygen concentrations generally occurred in the summer months when water temperatures were highest. Water-quality monitors were deployed at three depths in Dickinson Bayou. For periodically collected nutrients, the median concentration of ammonia nitrogen was largest in Dickinson Bayou and smallest in the San Bernard River. Median concentrations of ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus were largest in Armand Bayou. The median concentration of each of the four nutrients was larger for high-flow samples than for low-flow samples. The largest individual nutrient concentrations occurred during spring and summer. Both median and individual concentrations of chlorophyll-a were largest for Armand Bayou; median concentrations of pheophyton were similar for all three water bodies, and individual concentrations were largest for Armand Bayou. Median densities of fecal coliform bacteria and *E. coli* bacteria were similar for all three water bodies. Flow conditions had minimal effect on concentrations of chlorophyll-a and pheophytin, but the largest bacteria densities were in samples collected during high flow. Yields of most nutrients tended to increase with distance downstream. Yields in the San Bernard River and tributaries were less than yields in Dickinson and Armand Bayous. For Dickinson and Armand Bayous, the most individuals and species of fish were collected at the most downstream main stem site; for the San Bernard River, the fewest individuals and species of fish were collected at the most downstream main stem site.

INTRODUCTION

From July 2000 through September 2002, the U.S. Geological Survey (USGS) conducted a study in cooperation with the Houston-Galveston Area Council (H–GAC) and the Texas Commission on Environmental Quality (TCEQ) (formerly the Texas Natural Resource Conservation Commission) as a part of the Clean Rivers Program. The study involved collection and analysis of site-specific hydrologic, water-quality, and biological data in three water bodies in the Gulf Coastal Plain of Texas—Dickinson Bayou, Armand Bayou, and the San Bernard River and three of its tributaries (hereinafter referred to as the San Bernard River) (fig. 1).

Such data are of interest because segments of the three water bodies are on the State 303(d) list. Section 303(d) of the Clean Water Act requires states to submit to the U.S. Environmental Protection Agency annual listings of water bodies that are impaired—that is, they do not meet or are not expected to meet applicable TCEQ water-quality standards based on designated uses of the water bodies. The TCEQ uses water-quality data collected by several agencies to determine whether a water body meets the water-quality standards for its designated use.

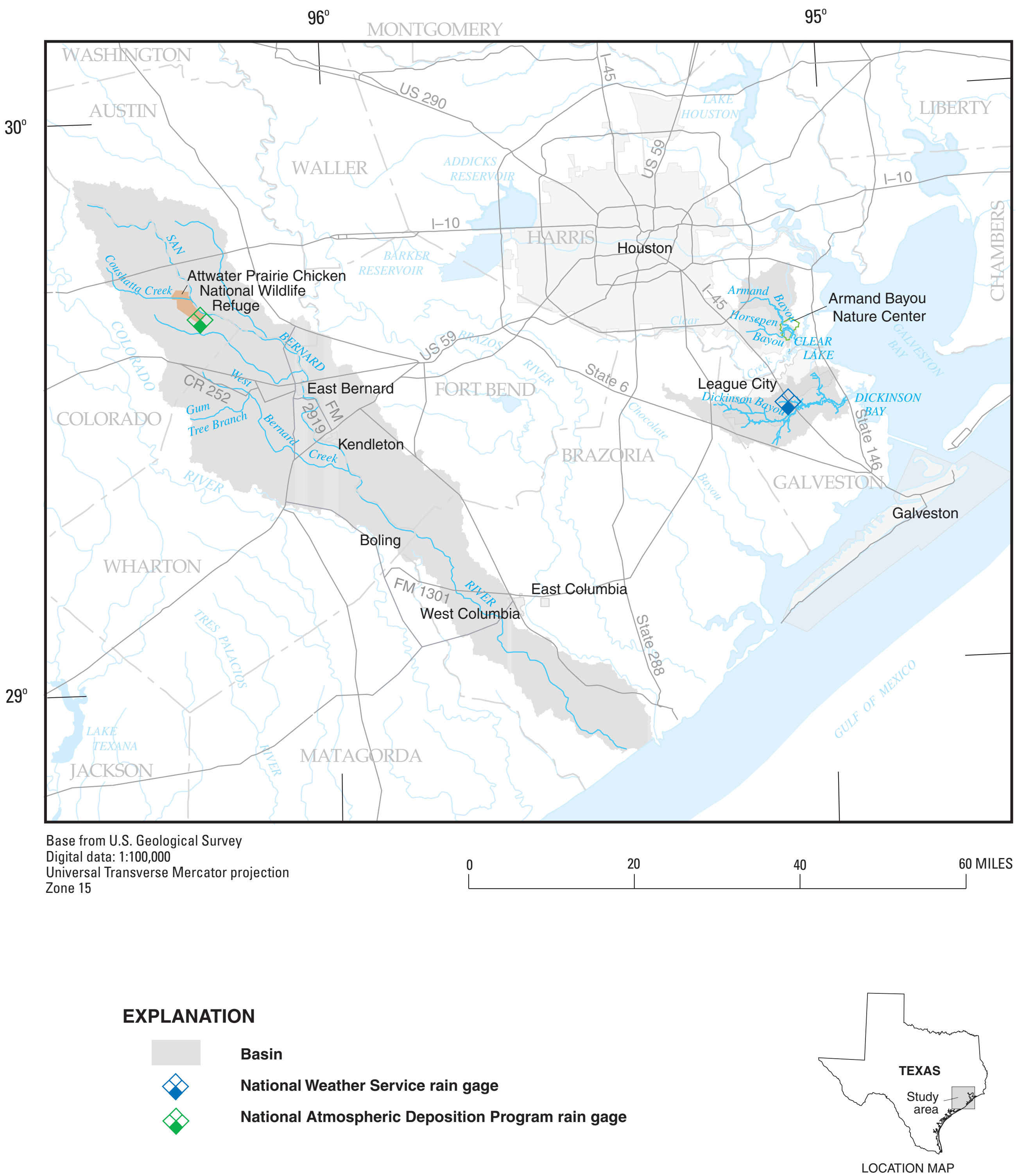

Figure 1. Location of Dickinson Bayou, Armand Bayou, and San Bernard River, Texas Gulf Coastal Plain, and rain gages in the area.

Section 303(d) further requires states to develop total maximum daily loads (TMDLs) for impaired water bodies. TMDLs set maximum amounts of pollutants that a water body can receive and still meet water-quality standards. Site-specific data thus are needed to define spatial and temporal variations in water-quality properties and constituents and in biological indicators of water quality. These data can contribute to a more complete understanding of water-quality conditions in a given water body and can indicate how appropriate State criteria are for that water body.

Purpose and Scope

The purpose of this report is to present hydrologic, water-quality, and biological data collected from Dickinson Bayou, Armand Bayou, and the San Bernard River during July 2000–September 2002. Tables and graphs present hydrologic data and water-quality properties that were collected at one site (station) in each of the three study areas at 15-minute intervals. Tables and graphs present water-quality properties and constituents sampled monthly at six sites in Dickinson Bayou, every other month at four sites in Armand Bayou, and every other month at six sites in the San Bernard River. Tables present fish, benthic macroinvertebrate, and stream-habitat data that were collected in or computed for each of the three water bodies. Biological data for Dickinson and Armand Bayous presented previously in Hogan (2002) is referred to but not repeated in this report.

Description of Water Bodies

Dickinson Bayou

Dickinson Bayou is about 25 miles (mi) southeast of Houston (fig. 2). The bayou is about 24 river miles long and is within Galveston County, although the westernmost part of the 106-square-mile (mi^2) drainage area (watershed) is in Brazoria County. All or parts of the cities of Dickinson, Alvin, Friendswood, Santa Fe, League City, and Texas City are in the watershed.

Dickinson Bayou flows eastward toward Dickinson Bay, a secondary bay of the Galveston Bay system. Dickinson Bayou is part of the San Jacinto-Brazos Coastal Basin and comprises two stream segments as defined by TCEQ. Stream segment 1104 is the Dickinson Bayou above-tidal reach, which flows 7.3 mi from Farm Road 528 to 1.2 mi downstream of Farm Road 517. Segment 1103 is the Dickinson Bayou tidal reach, which starts 1.2 mi downstream of Farm Road 517 and flows 16.4 mi to the Dickinson Bayou confluence with Dickinson Bay. Flow regimes in the two reaches are markedly different. The above-tidal reach is a relatively shallow stream (about 1 to 3 feet [ft] deep) with moving water, whereas the tidal reach is a predominantly deep channel (about 5 to 20 ft deep) with very sluggish flow. Streamside vegetation also is different. The above-tidal reach is characterized by dense, riparian vegetation that limits sunlight exposure, whereas vegetation in the tidal reach is less dense, which allows more exposure to sunlight. The topography of the watershed slopes gently toward the bayou. Land-surface altitude varies from about 50 ft above sea level in the west to sea level at the mouth of the bayou. Soils primarily are clays or loams with low permeability.

Land use varies from farmland and rangeland to concentrated residential and commercial development. The areas with the largest percentage of development are those near Dickinson and League City. About 10 percent of the basin is urban, 15 percent is pasture, and the remaining 75 percent is rural (East and others, 1998). Field inspections during the current study indicate that appreciable urban development near Dickinson has occurred since 1990, so it is likely that the percentage of the basin that is urban is greater than 10 percent.

In 1992, Dickinson Bayou was designated as “water-quality limited” by the Texas Water Commission (1992, p. 391). This designation means that stream-monitoring data indicated that surface-water-quality standards are not being met. In 2002, both stream segments were on the State 303(d) list because of elevated bacteria levels; segment 1103 (Dickinson Bayou tidal) also was listed because of small dissolved oxygen concentrations (Texas Commission on Environmental Quality, 2002).

Armand Bayou

Armand Bayou is about 20 mi southeast of Houston, north of Dickinson Bayou (fig. 2). Armand Bayou is about 14 river miles long and has a drainage area of about 63 mi^2, which includes the drainage area of Horsepen Bayou, a major tributary to Armand Bayou. The watershed, which is within Harris County, contains parts of the cities of Pasadena and Clear Lake, as well as the National Aeronautics and Space Administration (NASA) Johnson Space Center, Ellington Air Field, and the Bayport petrochemical complex.

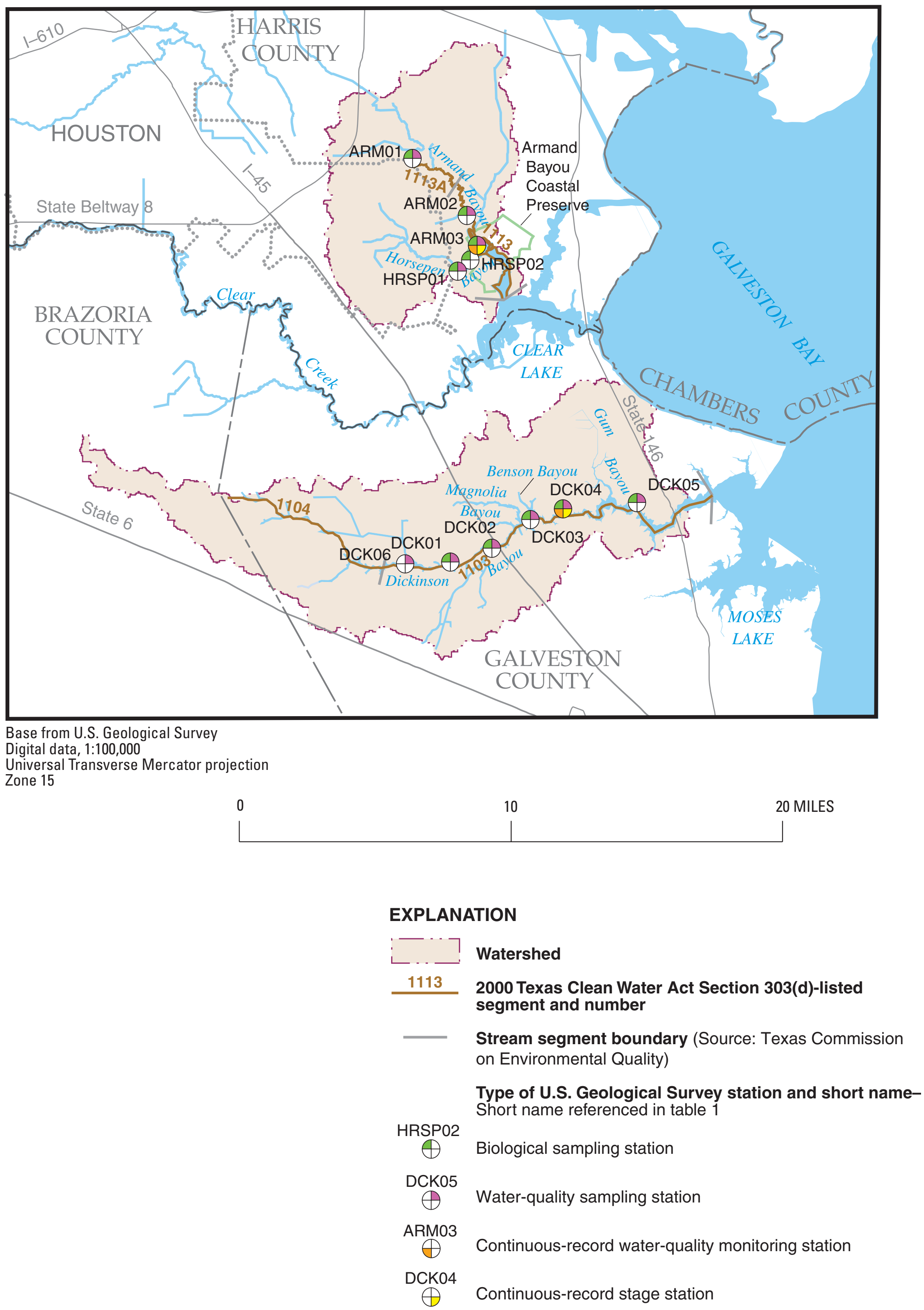

Figure 2. Location of sampling stations in Dickinson and Armand Bayous, Texas Gulf Coastal Plain, 2000–2002.

Armand Bayou flows southward through Mud Lake, then into Clear Lake (fig. 2). Armand Bayou is part of the San Jacinto-Brazos Coastal Basin and comprises two stream segments as defined by TCEQ. Stream segment 1113-A is the Armand Bayou above-tidal reach, which flows from the headwaters to a point 0.5 mi downstream of Genoa-Red Bluff Road. Segment 1113 is the Armand Bayou tidal reach, which flows from 0.5 mi downstream of Genoa-Red Bluff Road to the confluence with Clear Lake, at the NASA Road 1 bridge crossing. Flow regimes in the two reaches are similar to those in Dickinson Bayou. The above-tidal reach is a relatively shallow stream (about 1 to 2 ft deep) with moving water, whereas the tidal reach is much wider, with deep holes (about 5 to 10 ft) and very sluggish flow. The topography of the watershed slopes gently toward the bayou. Land-surface altitude varies from about 40 ft above sea level in the north to sea level at the mouth of the bayou. Coplin and Lanning-Rush (2002) show that land-surface subsidence of about 1 ft occurred in the Armand Bayou watershed during 1973–2001. It is likely that additional subsidence occurred prior to 1973, when monitoring equipment was installed. The effects of this physiographic change on the freshwater marsh system of Armand Bayou currently (2003) are unknown. However, it is anticipated that in this low-gradient watershed, land-surface subsidence of this magnitude could alter hydrodynamics (flow patterns, velocity, and so forth). Soils primarily are clays or loams with low permeability. Land use in the watershed has been categorized as residential, commercial, industrial, and undeveloped bottomland hardwood forest and coastal prairie (Parsons Engineering Science, Inc., 2000).

The Armand Bayou watershed is an important nursery and breeding habitat for fish and wildlife of the Galveston Bay estuarine system. The area also supports numerous nesting birds, mammals, reptiles, and amphibians. According to the Texas Parks and Wildlife Department (1997), "The Bayou and its watershed support biota and remnant habitats that were present during a more pristine era. It also functions as a flood control system, riparian habitat, and water quality mitigation area. The Bayou's uniqueness is that of a remnant natural system still existing within a heavily developed, densely populated region." Because of the ecological significance of Armand Bayou, in 1991 the Texas Parks and Wildlife Department established the 2,800-acre Armand Bayou Coastal Preserve.

In 1998, Armand Bayou was listed on the State 303(d) list because of elevated bacteria levels and small dissolved oxygen concentrations (Texas Natural Resource Conservation Commission, 1998). In 2002, additional data showed that the stream met criteria for contact recreation use, so the listing for elevated bacteria was removed. However, the stream was still listed for small dissolved oxygen concentrations (Texas Commission on Environmental Quality, 2002).

San Bernard River

The San Bernard River, which drains an appreciably larger watershed (more than 900 mi^2) than Dickinson Bayou (106 mi^2) and Armand Bayou (63 mi^2), is in the Brazos-Colorado Coastal Basin (fig. 3). The river flows southeast, forming the boundary between Austin and Colorado Counties, then into Wharton and Fort Bend Counties, before eventually flowing into the Gulf of Mexico. Total length of the river is about 125 mi. The San Bernard River comprises two stream segments as defined by TCEQ. Stream segment 1302 is the San Bernard River above-tidal reach, which flows from the city of New Elm in Austin County to a point 2.0 mi upstream of State Highway 35 in Brazoria County. Stream segment 1301 is San Bernard River tidal reach, which flows from 2.0 mi upstream of State Highway 35 in Brazoria County to the confluence with the Intracoastal Waterway in Brazoria County. Land use in the watershed primarily is rural and agricultural, with scattered areas of urbanization.

In 2002, segment 1302 (San Bernard River above tidal) was on the 303(d) list for not supporting contact recreation use because of elevated bacteria levels, not supporting general use because of elevated water temperature, and concerns that fish and benthic macroinvertebrate communities were impaired in the stream segment (Texas Commission on Environmental Quality, 2002). All designated stream uses for segment 1301 (San Bernard River tidal) were fully supported, thus that segment was not on the 303(d) list.

Acknowledgments

The authors thank Todd Running, Patrick Horton, and Karen Brettschneider, H–GAC, and Laurie Curra, TCEQ, for providing assistance throughout the study. Jim McLaughlin and Chuck Wemple, formerly of H–GAC, assisted during the planning and data-collection stages of the study. Also, Jean Wright and Roy Drinnen, Galveston County Health District

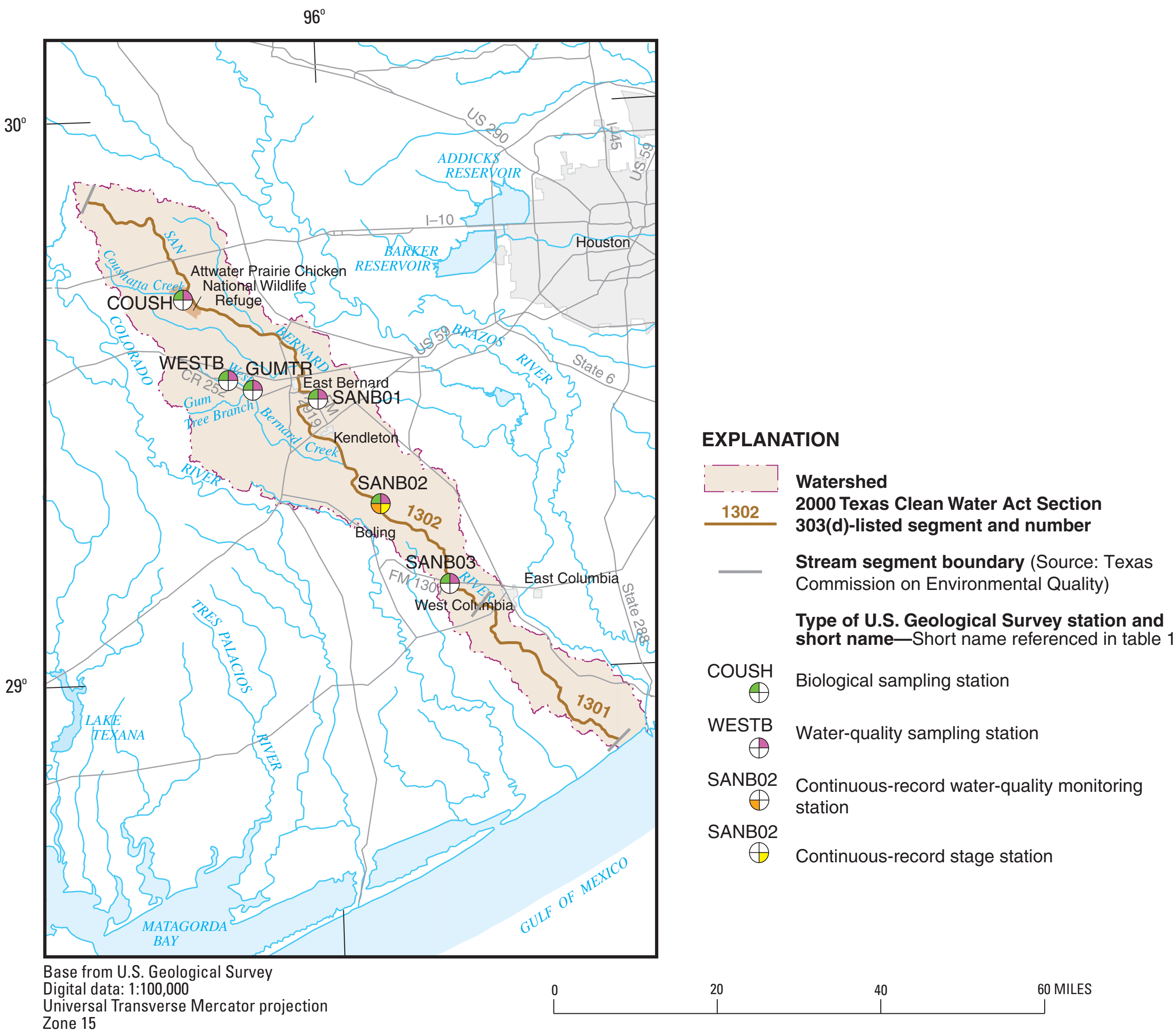

Figure 3. Location of sampling stations in San Bernard River and three tributaries, Texas Gulf Coastal Plain, 2000–2002.

(GCHD), and others from GCHD and TCEQ provided invaluable assistance during field data-collection activities. Staff of the University of Texas Memorial Museum assisted by identifying unknown fish species. Additionally, the authors gratefully acknowledge the City of Pasadena, City of Dickinson, and Texas Department of Transportation for permission to install and operate equipment during the study.

DATA COLLECTION

A variety of data were collected during the 26-month study period to characterize water-quality and biological conditions in the three water bodies, both spatially and temporally. The data were hydrologic properties (rainfall, stage, and streamflow), continuously monitored water-quality properties (water temperature, specific conductance, pH, and dissolved oxygen), periodically monitored water-quality properties and constituents (nutrients, phytoplankton, indicator bacteria, suspended sediment, and biochemical oxygen demand [BOD]), and biological properties (fish, benthic macroinvertebrates, and stream habitat). The data-collection activities are summarized in table 1. In addition to environmental samples, quality assurance (QA) samples also were collected during the study.

Table 1. Data-collection sites in Dickinson Bayou, Armand Bayou, and San Bernard River, Texas Gulf Coastal Plain, 2000–2002

[IH, Interstate Highway; SH, State Highway; CR, County Road; FM, Farm Road]

Station number	Station name	Short name (fig. 2 or 3)	Location: Latitude	Location: Longitude	Drainage area (square miles)	Population density[1] (people per square mile)	Data-collection activity
			Dickinson Bayou				
0807764230	Dickinson Bayou at Ginger Rd., near Alvin, Tex.	DCK06	29°25'39"	95°07'54"	31.2	291	Monthly water-quality sampling
08077643	Dickinson Bayou at Cemetary Rd. near Dickinson, Tex.	DCK01	29°25'45"	95°06'56"	43.6	296	Monthly water-quality sampling Biological sampling
08077645	Dickinson Bayou near IH–45, Dickinson, Tex.	DCK02	29°26'40"	95°04'23"	57.3	296	Monthly water-quality sampling Biological sampling
0807764550	Dickinson Bayou upstream of Benson Bayou, Dickinson, Tex.	DCK03	29°27'18"	95°03'42"	67.4	337	Monthly water-quality sampling Biological sampling
08077647	Dickinson Bayou at SH 3, Dickinson, Tex.	DCK04	29°27'23"	95°02'52"	75.0	402	Continuous stage Continuous water-quality monitoring Monthly water-quality sampling Biological sampling
0807764915	Dickinson Bayou below Gum Bayou, near Texas City, Tex.	DCK05	29°27'40"	94°59'59"	93.5	502	Monthly water-quality sampling Biological sampling
			Armand Bayou				
293847095074501	Armand Bayou at Fairmont Pkwy., Pasadena, Tex.	ARM01	29°38'47"	95°07'45"	7.71	3,160	Bimonthly water-quality sampling Biological sampling
293645095054601	Armand Bayou at Oil Field Rd., Pasadena, Tex.	ARM02	29°36'45"	95°05'46"	25.4	2,190	Bimonthly water-quality sampling Biological sampling
293546095052701	Armand Bayou at Bay Area Blvd., Pasadena, Tex.	ARM03	29°35'46"	95°05'27"	35.3	1,940	Continuous stage Continuous water-quality monitoring Bimonthly water-quality sampling Biological sampling
08077630	Horsepen Bayou at Bay Area Blvd., Houston, Tex.	HRSP01	29°35'00"	95°06'12"	16.7	2,240	Bimonthly water-quality sampling Biological sampling
293444095055101	Horsepen Bayou at Middlebrook Dr., Pasadena, Tex.	HRSP02	29°34'44"	95°05'51"	17.4	2,190	Biological sampling
			San Bernard River and tributaries				
294036096165001	Coushatta Creek at Attwater Prairie Chicken National Wildlife Refuge, Tex.	COUSH	29°40'36"	96°16'50"	39.9	10	Bimonthly water-quality sampling Biological sampling
293211096110301	West Bernard Creek at CR 252, near East Bernard, Tex.	WESTB	29°32'11"	96°11'03"	22.1	39	Bimonthly water-quality sampling Biological sampling

Table 1. Data-collection sites in Dickinson Bayou, Armand Bayou, and San Bernard River, Texas Gulf Coastal Plain, 2000–2002—Continued

Station number	Station name	Short name (fig. 2 or 3)	Location: Latitude	Location: Longitude	Drainage area (square miles)	Population density[1] (people per square mile)	Data-collection activity
			San Bernard River and tributaries—Continued				
293123096073001	Gum Tree Branch at CR 252, near East Bernard, Tex.	GUMTR	29°31'23"	96°07'30"	35.1	29	Bimonthly water-quality sampling Biological sampling
292939096014001	San Bernard River at FM 2919 near Kendleton, Tex.	SANB01	29°29'39"	96°01'40"	375	24	Bimonthly water-quality sampling Biological sampling
08117500	San Bernard River near Boling, Tex.	SANB02	29°18'48"	95°53'37"	727	30	Continuous streamflow Continuous water-quality monitoring Bimonthly water-quality sampling Biological sampling
290935095455601	San Bernard River at FM 1301 near East Columbia, Tex.	SANB03	29°09'35"	95°45'56"	825	32	Bimonthly water-quality sampling Biological sampling

[1] See text, page 27.

Depending on the constituent type, QA samples consisted of equipment blanks, field blanks, laboratory blanks, split samples, replicate samples, and laboratory matrix spikes.

Hydrologic Data

All precipitation during the study was rainfall. Rainfall data were obtained from two sources: (1) the National Weather Service (NWS) station at League City (National Weather Service, 2003) (fig. 1)—data from this station are representative of conditions for both Dickinson Bayou and Armand Bayou; and (2) the National Atmospheric Deposition Program (NADP) station at the Attwater Prairie Chicken National Wildlife Refuge near Sealy (National Atmospheric Deposition Program [NRSP–3]/National Trends Network, 2003) (fig. 1)—data from this station were assumed to be representative of the San Bernard study area.

Gage height (stage) was continuously monitored in each of the three water bodies (figs. 2, 3; table 1). Gage height at the Dickinson Bayou and Armand Bayou gages is tidally influenced. Gage height (stage) is defined as the water surface measured in feet above a local reference point, or "gage datum." For the Dickinson Bayou and Armand Bayou gages, the gage datum was arbitrarily chosen and not referenced to a particular datum. Gage height data for the San Bernard River gage were referenced to NGVD 29.

Gage height data were measured using pressure transducers. The data were electronically recorded at 15-minute intervals by data-collection platforms (DCPs) and transmitted by a geostationary operational environmental satellite (GOES) at 4-hour intervals to the USGS National Water Information System database. Streamflow was computed from gage height data for the San Bernard River station by using a pre-existing rating curve, which relates gage height to instantaneous streamflow. This rating curve was developed using standard USGS procedures (Rantz and others, 1982). Stage-discharge relations could not be developed for the Dickinson Bayou and Armand Bayou gages because they are tidally influenced.

In addition to continuous hydrologic data collected at the three stations, instantaneous measurements of streamflow were made during each site visit using standard USGS procedures (Rantz and others, 1982; Simpson (2001). Depending on site conditions, velocities were measured using either Price pygmy velocity meters, Price type AA velocity meters, or acoustic Doppler current profilers (ADCPs). When conditions allowed, wading measurements were made and top-setting wading rods were used to measure the depth of flow and to suspend the velocity meter in the water column. When depths of flow or velocities were too great,

measurements were made by suspending instruments from nearby bridges or by deploying a boat-mounted ADCP.

Water-Quality Data

Continuously Monitored Water-Quality Properties

Water temperature, specific conductance, pH, and dissolved oxygen were measured using multi-probe water-quality meters and electronically recorded at 15-minute intervals by the DCPs. In each application, the meters were installed near the center of flow and were operated as documented in Wagner and others (2000).

The continuous monitoring station in Dickinson Bayou (fig. 2; table 1) was located in a relatively deep (about 20 ft) section of the bayou. Because flow reverses with tidal fluctuations, the potential for stratification of water-quality properties associated with density differences between saltwater (heavier) and freshwater (lighter) existed. During field reconnaissance, the occurrence of a “salt-wedge” along the bottom was verified by measured differences in specific conductance with depth. The occurrence of such a wedge can lead to small dissolved oxygen concentrations at depths. Because of the stratification, three multi-probe water-quality monitors were deployed at the State Highway 3 bridge station, one near the bottom (depth about 18 ft), one near the center (depth about 10 ft), and one near the top (depth about 2 ft). The meter was operational during December 2000–September 2001.

The continuous monitoring station in Armand Bayou (fig. 2; table 1) was installed in a relatively wide (greater than 300 ft) and shallow (about 3 ft) section of the bayou. As was the case in Dickinson Bayou, the station was in the tidal segment of Armand Bayou. Because of the shallow depth, deployment of instruments at multiple depths was not practical. R.S. Burgess (Texas Commission on Environmental Quality, written commun., 2003) indicates that “density stratification due to both temperature and salinity” does occur in Armand Bayou and that “pronounced vertical gradients of dissolved oxygen” also have been observed at locations in the bayou. The multi-probe water-quality meter was set to a depth of about 2 ft. The meter was operational during December 2000–August 2001.

The continuous monitoring station in the San Bernard River (fig. 3; table 1) was installed in a riverine setting, with typical water depths of 3 ft and constant flow. The multi-probe water-quality meter was deployed at a depth of about 2 ft, although the exact depth of the meter was dependent upon water depth at any given time. The range in stage at this station (about 3 to 33 ft) during the study was greater than the ranges at the stations in Dickinson and Armand Bayous. The meter was in place during December 2000–August 2002. However, because of vandalism, it was not operational from mid-July 2001 to mid-December 2001.

Periodically Collected Water-Quality Properties and Constituents

Selected water-quality properties and constituents were collected periodically and measured by laboratory analysis. Principally, these were nutrients (ammonia nitrogen, ammonia plus organic nitrogen, nitrite nitrogen, nitrite plus nitrate nitrogen, orthophosphorus), phytoplankton (chlorophyll-a, pheophytin), and indicator bacteria (fecal coliforms, fecal streptococci, *E. coli*, and enterococci). Five-day BOD and suspended sediment also were collected periodically at Armand Bayou and the San Bernard River. Laboratories responsible for each type of analysis are listed in table 2.

The GCHD and TCEQ collected samples at Dickinson Bayou monthly during July 2000–August 2001 following TCEQ methods (Texas Natural Resource Conservation Commission, 1999). The GCHD laboratory analyzed the samples for ammonia nitrogen, nitrite plus nitrate nitrogen, orthophosphorus, fecal coliform bacteria, *E. coli* bacteria, and enterococci bacteria. The TCEQ laboratory analyzed the samples for ammonia plus organic nitrogen, chlorophyll-a, and pheophytin. All data were collected in conformance with a detailed Quality Assurance Project Plan (QAPP) that specified rigorous cleaning and sampling procedures and included the collection and analysis of appropriate QA samples. Analytical results for the monthly samples were obtained in electronic format from the GCHD and TCEQ.

The USGS collected water samples at Armand Bayou in August 2000 and in January, March, May, and July 2001. Water samples for Armand Bayou were collected and processed using standard USGS methods (U.S. Geological Survey, 1997–present).

The USGS collected water samples every other month at six sites in the San Bernard River during January 2001–August 2002. Again, water samples were collected and processed using standard USGS procedures.

Table 2. Laboratories responsible for analyses of samples collected from Dickinson Bayou, Armand Bayou, and San Bernard River, Texas Gulf Coastal Plain, 2000–2002

[GCHD, Galveston County Health District; TCEQ, Texas Commission on Environmental Quality; USGS-NWQL, U.S. Geological Survey National Water Quality Laboratory; USGS-HOU, U.S. Geological Survey Houston Subdistrict; EcoAnalysts, EcoAnalysts Inc. contract laboratory]

Water body	Laboratory responsible for analysis			
	Nutrients	Phytoplankton	Indicator bacteria	Benthic macroinvertebrate
Dickinson Bayou	GCHD/TCEQ	TCEQ	GCHD	USGS-NWQL
Armand Bayou	USGS-NWQL	USGS-NWQL	USGS-HOU	USGS-NWQL
San Bernard River	USGS-NWQL	USGS-NWQL	USGS-HOU	EcoAnalysts

Note: Five-day biochemical oxygen demand for Armand Bayou and San Bernard River analyzed by USGS Houston Subdistrict; suspended sediment for Armand Bayou and San Bernard River analyzed by USGS Louisiana District.

QA samples were collected at the same time that environmental samples were collected. Equipment blanks and field blanks were used to verify the adequacy of cleaning procedures. Split samples were used to determine the analytical precision (reproducibility) for various constituents. Concurrent samples were used to provide a measure of sampling precision (reproducibility) and to indicate spatial or temporal inhomogeneities in the system being sampled. Results of concurrent samples also can reflect differences in sampling, processing, and laboratory analysis. In the QAPP, the stated QA objective for sampling and analytical precision was a relative percent difference (RPD) of less than 20 percent. The RPDs of all split and concurrent samples were less than 20 percent. If equipment blanks or field blanks were greater than QA limits (two times the minimum reporting level or 10 percent of the environmental value), a remark code of "V" (indicating contamination) precedes the values listed in the associated tables.

Biological Data

Prior to biological sampling, appropriate stream reaches were selected. Potential reaches were identified using geographic information system (GIS) maps of the three water bodies. Final reaches were selected after on-site reconnaissance. A primary selection criterion was that a reach must contain a full meander (s-shaped curve) of the channel. The sampling sites are located within the selected stream reaches adjacent to the station locations listed in table 1, and the frequency of each type of sampling in each water body is listed in table 3.

Table 3. Biological sampling frequency in Dickinson Bayou, Armand Bayou, and San Bernard River, Texas Gulf Coastal Plain

[QMH, qualitative multi-habitat method; DTH, depositional-targeted habitat method; RTH, richest-targeted habitat method]

Water body	Data-collection activity	Sampling frequency
Dickinson Bayou	Stream habitat	Summer 2000
	Fish survey	Summer 2000 Winter 2001 Summer 2002
	Benthic macroinvertebrate sampling (QMH and DTH methods)	Summer 2000 Winter 2001 Summer 2002
Armand Bayou	Stream habitat	Summer 2000
	Fish survey	Summary 2000 Winter 2001
	Benthic macroinvertebrate sampling (QMH, DTH, and RTH methods)	Summer 2000 Winter 2001
San Bernard River	Stream habitat	Spring 2001
	Fish survey	Summer 2000 Spring 2001 Summer 2002
	Benthic macroinvertebrate sampling (QMH and RTH methods)	Summer 2000 Spring 2001 Spring 2002

Fish, benthic macroinvertebrate, and stream-habitat data-collection methods used in Dickinson and Armand Bayous are summarized in Hogan (2002). The same methods were used to collect biological data in the San Bernard River.

HYDROLOGIC DATA

Figure 4a shows rainfall data collected at the NWS station at League City, and figure 4b shows rainfall data collected at the NADP station at the Attwater Prairie Chicken National Wildlife Refuge near Sealy. Rainfall distributions for the two locations were similar in terms of timing and magnitude. However, in June 2001, more than 20 inches (in.) of rain was recorded at League City (Dickinson and Armand Bayous), most of which was associated with Tropical Storm Allison. The NADP station (San Bernard River) received much less rainfall (less than 2 in.) from this storm.

Figures 5a and 5b show comparable gage height fluctuations between the Dickinson Bayou and Armand Bayou gages. The gage height timing and pattern were essentially the same at the two sites, but the magnitudes of tidal fluctuation were different. The dates of water-quality sample collection for the two sites also are shown.

Streamflow data were computed for the continuous monitoring station on the San Bernard River. Figure 6 shows the range in daily mean streamflow at the San Bernard River gage during the study period. The dates of water-quality sample collection also are shown.

WATER-QUALITY DATA

Continuously Monitored Water-Quality Properties

In addition to hydrologic data (stage and discharge) that were collected at one station in each of the three water bodies, water temperature, specific conductance, pH, and dissolved oxygen also were collected at these three stations using multi-probe water-quality monitors. Boxplots show these data, grouped by month, for each of the three water bodies (figs. 7–10). Data are presented during November 2000–August 2001 because this was the only period when all three monitors were operational at the same time.

Seasonal variations in water-quality properties for all three sites are typical of those observed at USGS stations along the Texas Gulf Coast. In particular, water temperature (fig. 7) and dissolved oxygen (fig. 10) are inversely related. Periods of smallest dissolved oxygen concentrations generally occurred in the summer months when water temperatures were highest.

Because water-quality conditions were stratified during field reconnaissance, monitors were deployed at three depths at the Dickinson Bayou continuous monitoring station. Distributions of these water-quality parameters are shown in figure 11a–d. The boxplots indicate that water temperature was slightly higher near the surface than at mid-depth and near bottom; specific conductance increased with depth, particularly near bottom; pH was less variable near the surface; and dissolved oxygen concentrations decreased with depth. Examination of specific conductance data indicates that substantial stratification occurs through the water column. A salinity gradient that exceeded 6,000 microsiemens per centimeter at 25 degrees Celsius occurred at one station in summer months during periods of limited freshwater inflow. During these same periods, dissolved oxygen concentrations typically were much smaller in the bottom depths than at the middle and top depths. During periods of elevated streamflow (after rainfall), mixing occurred, and stratification was less prevalent.

Periodically Collected Water-Quality Properties and Constituents

Selected water-quality properties and constituents were analyzed for six sites in Dickinson Bayou (table 4, at end of report), four sites in Armand Bayou (table 5, at end of report), and six sites in the San Bernard River (table 6, at end of report). Graphical comparisons were made to show differences in selected water-quality constituents collected from the three water bodies. For these comparisons, data were grouped by water body, by flow condition, and by season. In addition, constituent yields were computed for selected constituents. Only water-quality constituents that were analyzed for all three water bodies were used for these comparisons and computations. The constituents are ammonia nitrogen, ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, orthophosphorus, chlorophyll-a, pheophytin, fecal coliform bacteria, and *E. coli* bacteria.

The TCEQ has developed thresholds, or screening levels, for selected water-quality constituents that indicate elevated concentrations for constituents for which water-quality standards have not been adopted (Texas Commission on Environmental Quality, 2003). When sample concentrations exceed screening levels, they indicate a potential water-quality concern.

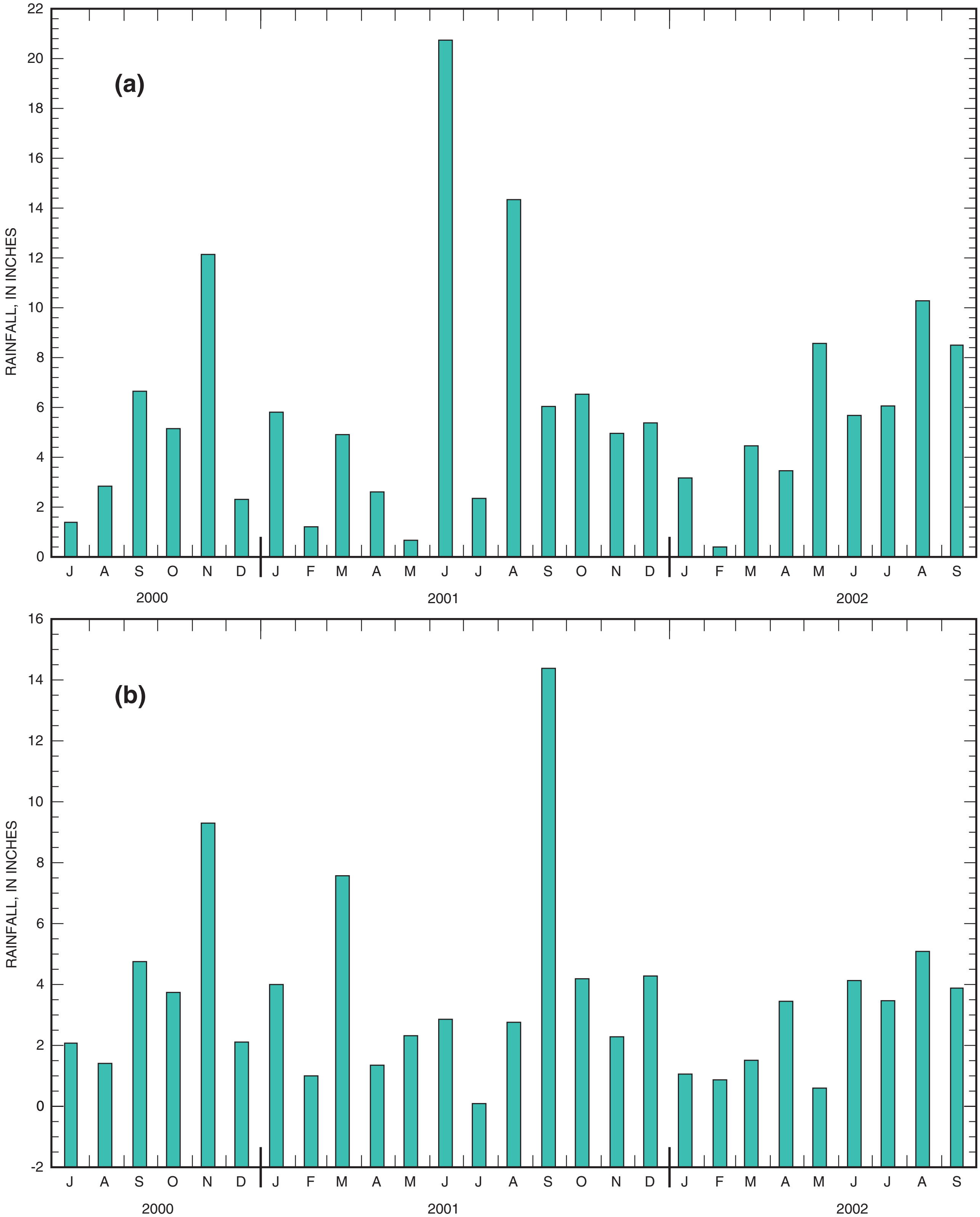

Figure 4. Rainfall at (a) National Weather Service station, League City, Texas, and (b) National Atmospheric Deposition Program station, Attwater Prairie Chicken National Wildlife Refuge near Sealy, Texas, July 2000–September 2002.

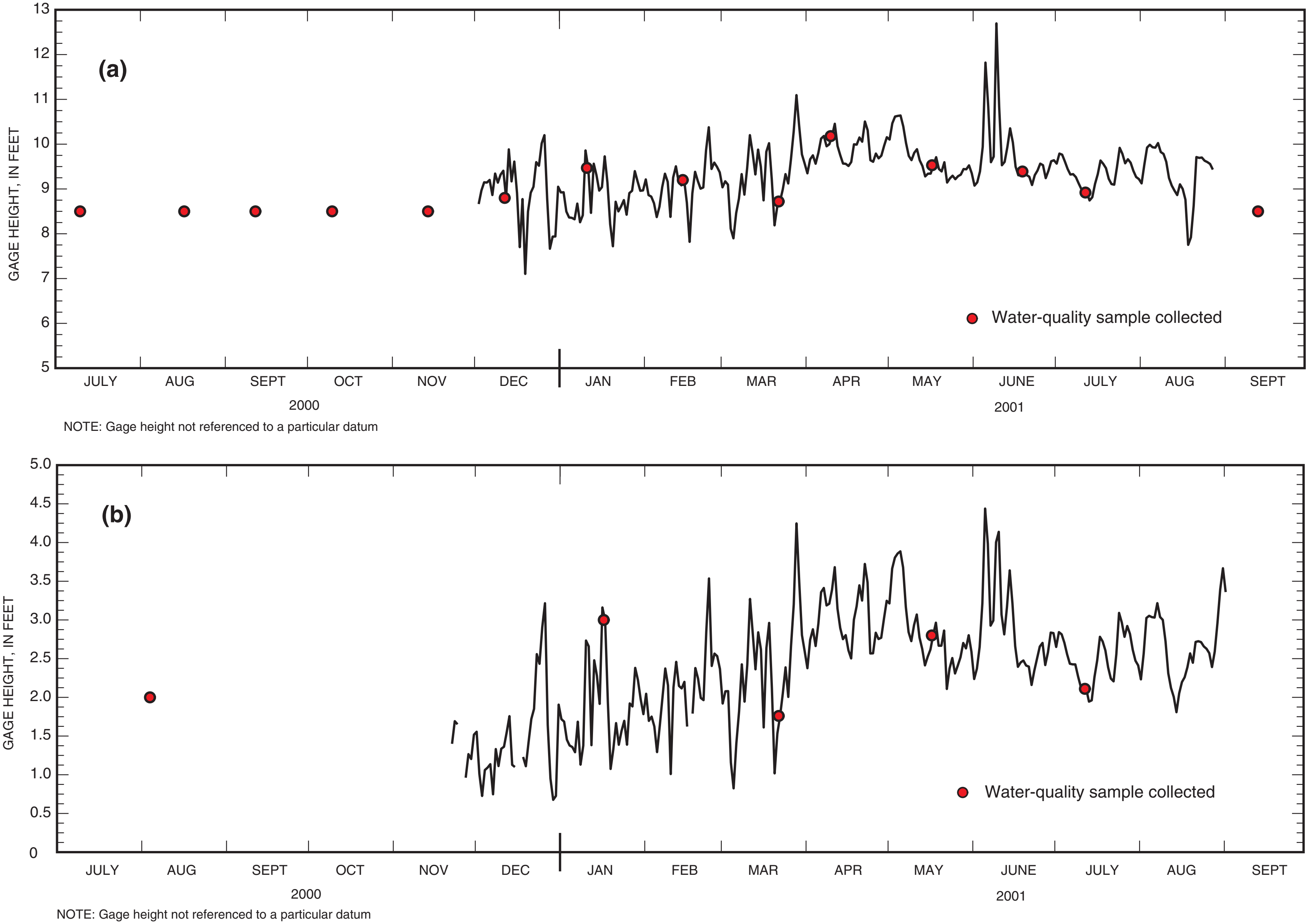

Figure 5. Hydrographs showing daily mean gage height and time of water-quality sampling at (a) station 08077647 Dickinson Bayou at State Highway 3, Dickinson, Texas, and (b) station 293546095052701 Armand Bayou at Bay Area Boulevard, Pasadena, Texas, July 2000–September 2001.

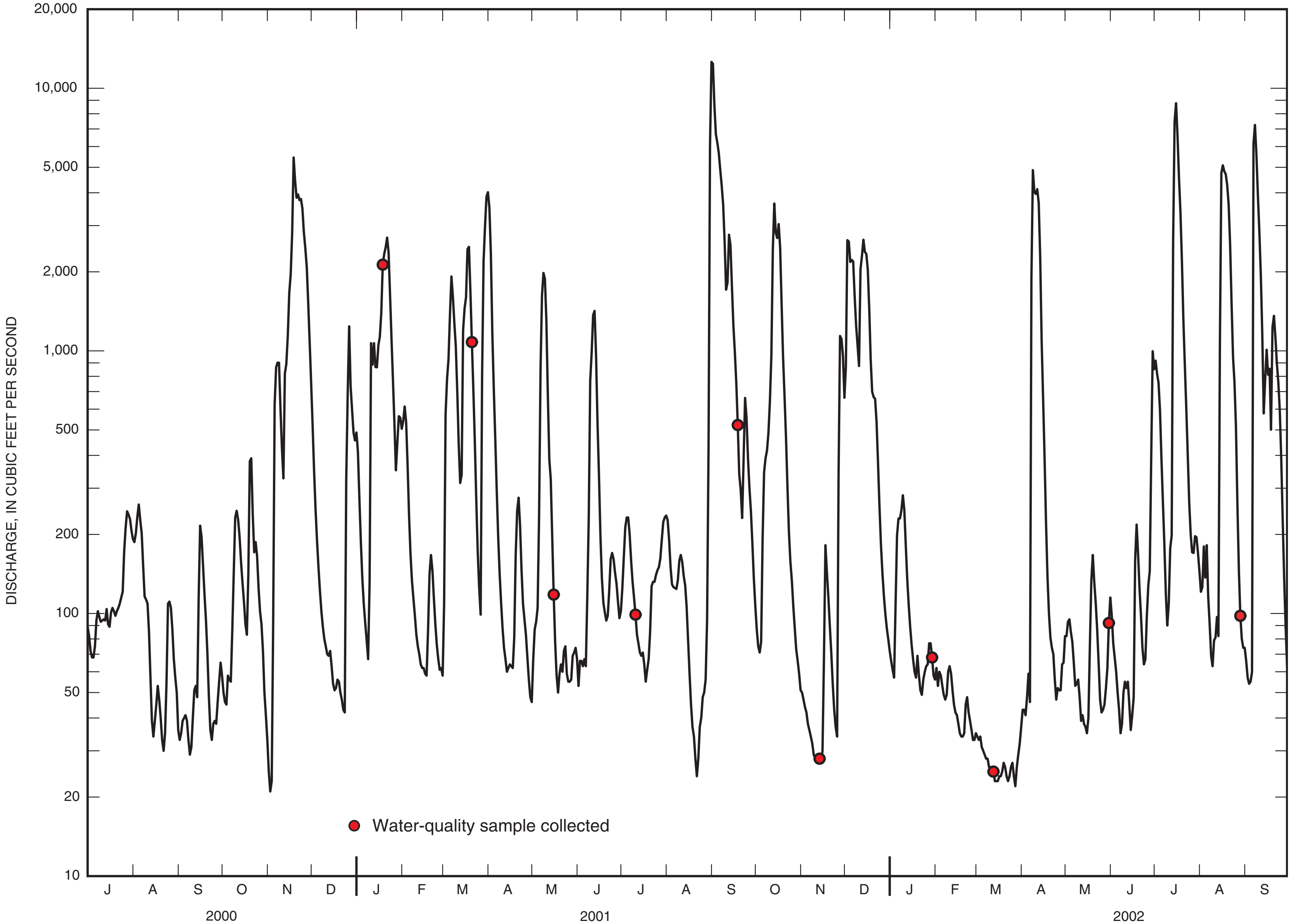

Figure 6. Hydrographs showing daily mean discharge and time of water-quality sampling at station 08117500 San Bernard River near Boling, Texas, July 2000–September 2002.

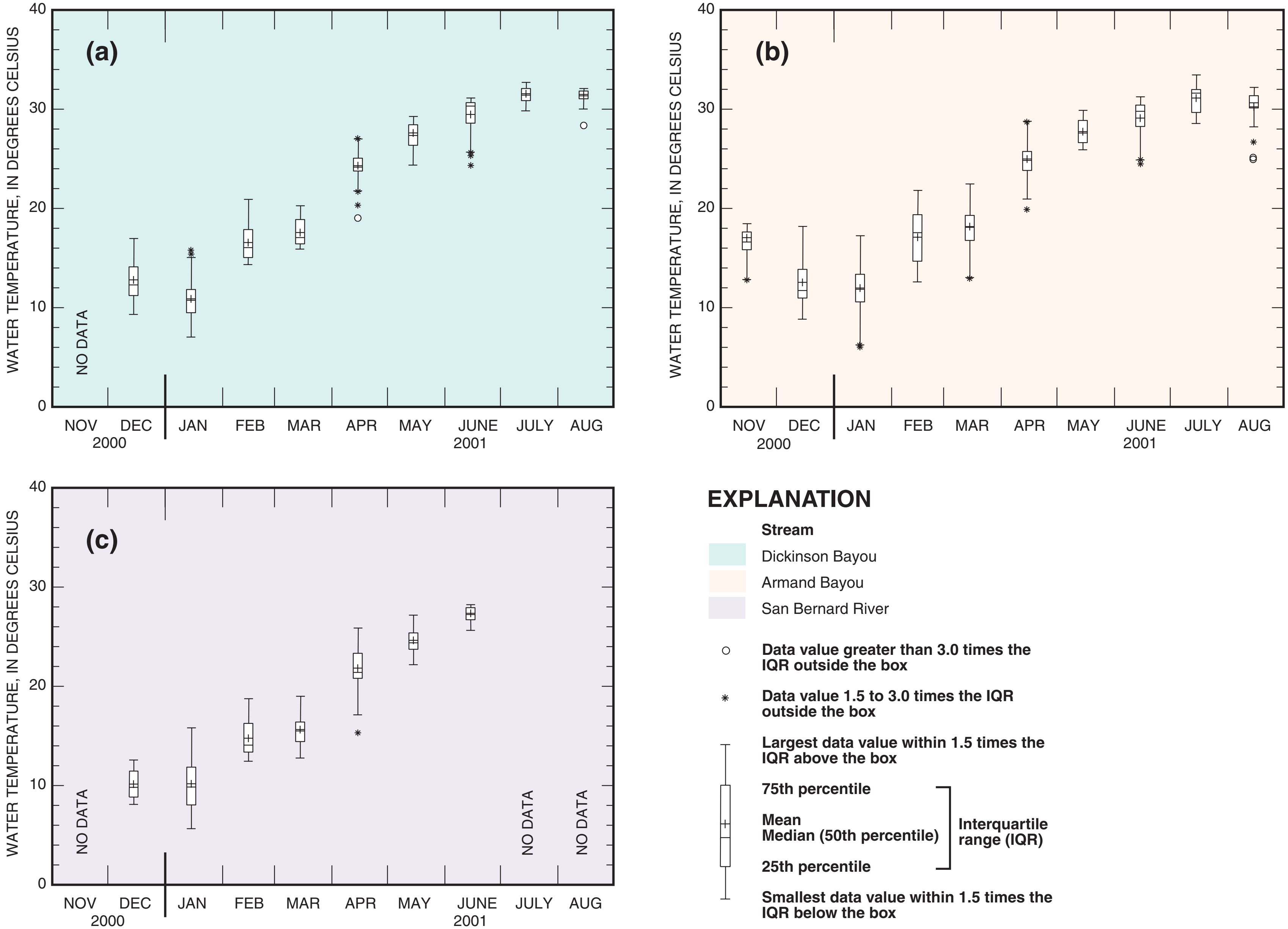

Figure 7. Distribution of continuously recorded (15-minute interval) water temperature in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, November 2000–August 2001.

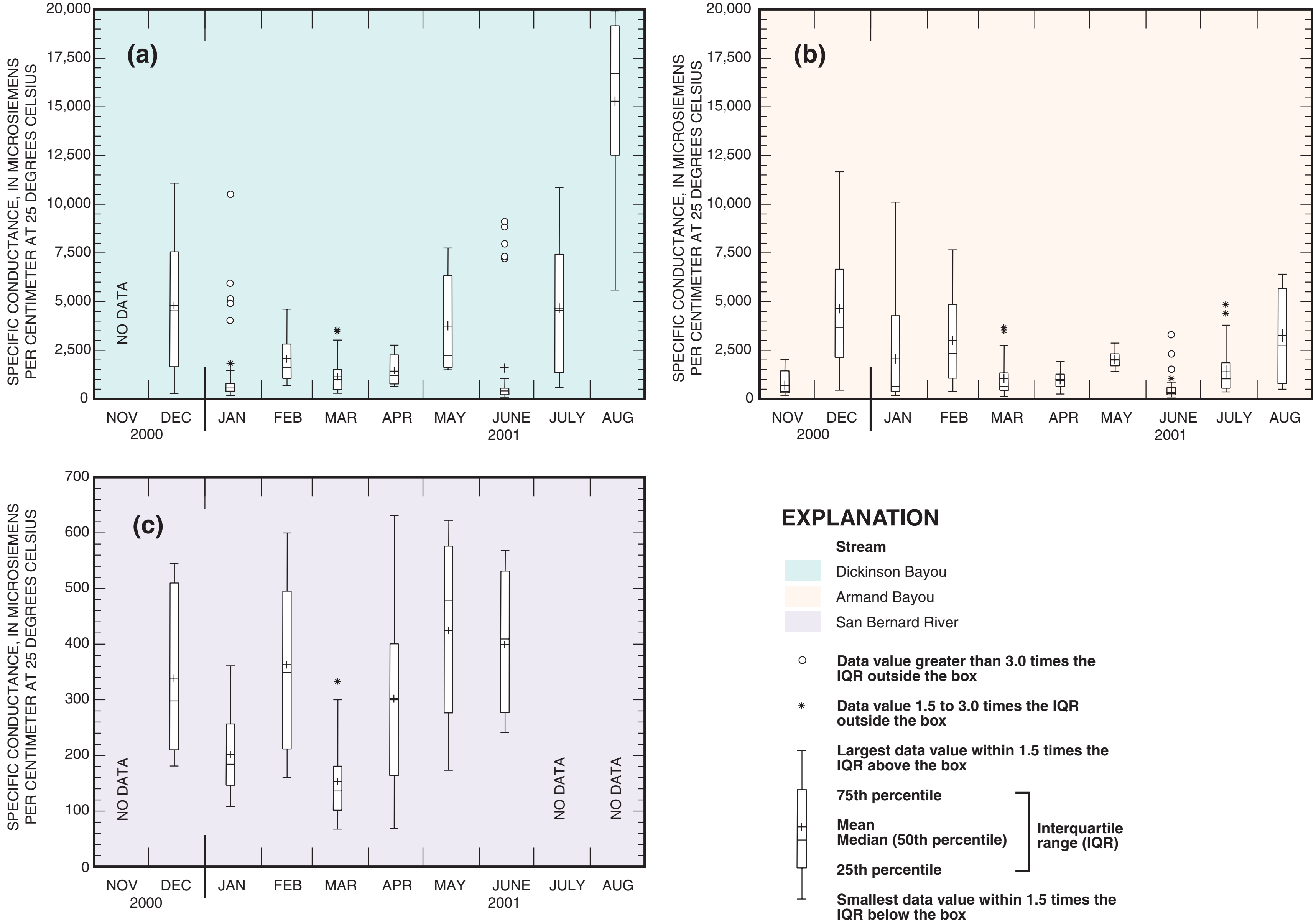

Figure 8. Distribution of continuously recorded (15-minute interval) specific conductance in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, November 2000–August 2001.

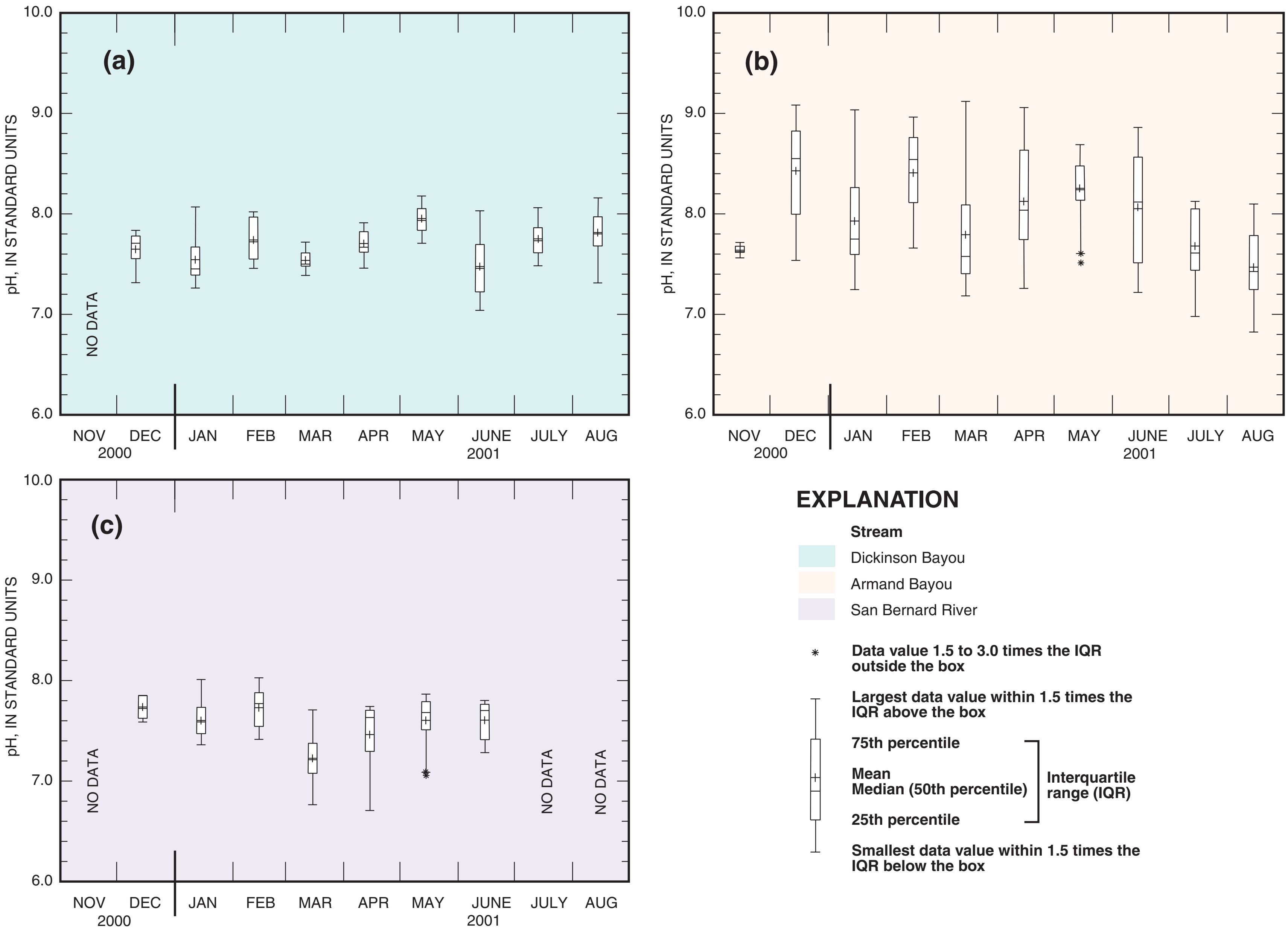

Figure 9. Distribution of continuously recorded (15-minute interval) pH in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, November 2000–August 2001.

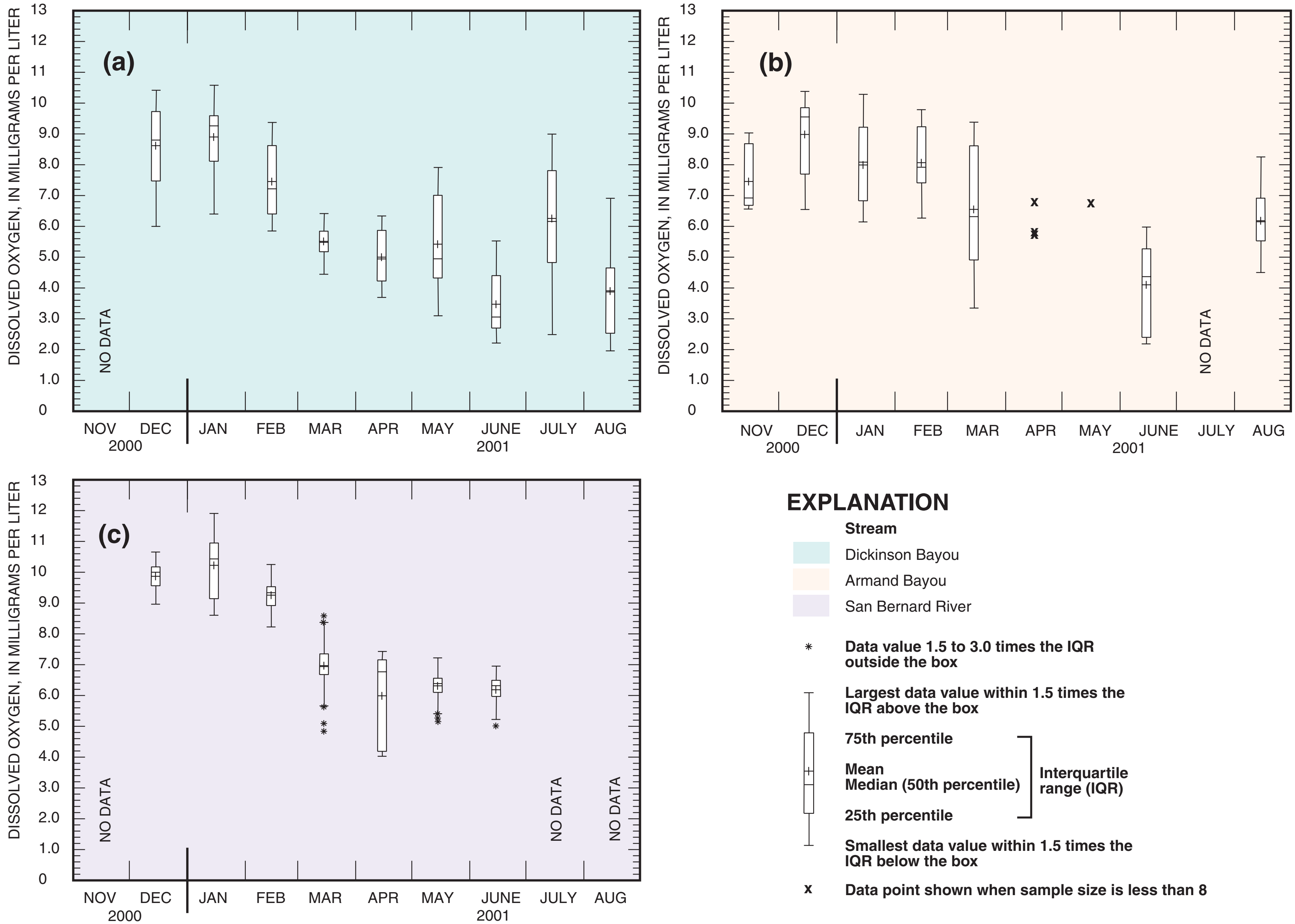

Figure 10. Distribution of continuously recorded (15-minute interval) dissolved oxygen in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, November 2000–August 2001.

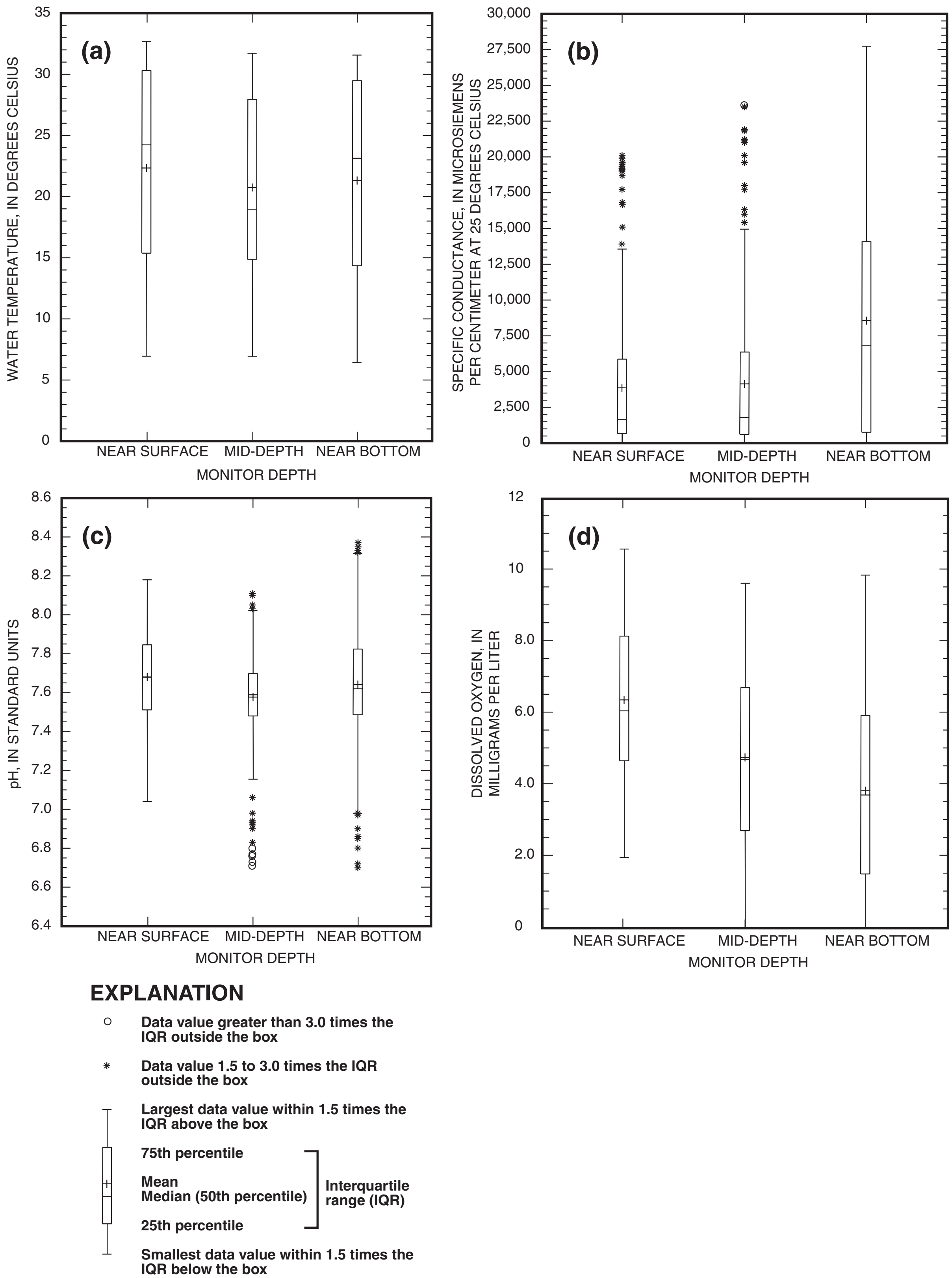

Figure 11. Distribution of continuously recorded (15-minute interval) (a) water temperature, (b) specific conductance, (c) pH, and (d) dissolved oxygen at three depths in Dickinson Bayou, Texas Gulf Coastal Plain, December 2000–August 2001.

Table 7. Screening levels for selected nutrients (Texas Commission on Environmental Quality, 2003)

[mg/L, milligrams per liter; µg/L, micrograms per liter]

Stream type	Screening level			
	Ammonia nitrogen (mg/L)	Nitrite plus nitrate nitrogen (mg/L)	Orthophosphorus (mg/L)	Chlorophyll-a (µg/L)
Freshwater	0.17	2.76	0.80	11.6
Tidal	.58	1.83	.71	19.2

Screening levels for selected nutrients have been developed for freshwater streams, tidal streams (table 7), reservoirs, and estuaries.

Nutrients

Distributions of ammonia nitrogen, ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus concentrations are shown by boxplots grouped by water body (fig. 12). Dickinson Bayou had the largest median ammonia nitrogen concentration; the San Bernard River had the smallest median concentration but the largest range in concentration. Armand Bayou had the largest median concentrations of ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus.

The effect of variations in stream discharge on nutrient concentrations is evident when these data are grouped by flow condition (fig. 13). Samples collected during base-flow conditions were designated low flow, and samples collected during above base flow conditions were designated high flow. The median concentration of each of the four nutrients was larger for high-flow samples than for low-flow samples. However, the largest individual concentrations and ranges in concentration occurred in low-flow samples.

Seasonality was reflected by grouping data from all three water bodies by the time of the year they were collected (fig. 14). Samples collected during September–November were designated fall; December–February, winter; March–May, spring; and June–August, summer. Although no discernible pattern of seasonality was evident, the largest individual concentrations and ranges in concentration occurred during spring and summer (growing seasons).

Chlorophyll-a and Pheophytin

Both the median and individual concentrations of chlorophyll-a were largest for Armand Bayou (fig. 15). Median concentrations of pheophytin were similar for all three water bodies (all less than 5 micrograms per liter [µg/L]). The largest individual pheophytin concentrations were from Armand Bayou.

Chlorophyll-a and pheophytin concentrations were grouped by flow condition (low flow and high flow, as per nutrients) in boxplots (fig. 16). The median concentrations of low-flow and high-flow samples were similar, less than 5 µg/L for both. However, the largest individual concentrations of each were measured in low-flow samples. The distributions are similar to those of nutrient concentrations grouped by flow condition (fig. 13).

Seasonal distributions of chlorophyll-a and pheophytin are shown in figure 17. The largest median concentration of chlorophyll-a is in summer, and the largest median concentration of pheophytin is in spring. Similar to seasonally grouped nutrient concentrations (fig. 14), the largest individual concentrations of chlorophyll-a and pheophytin occurred in the spring and summer, during the growing seasons.

Indicator Bacteria

Median densities of fecal coliform bacteria and *E. coli* bacteria were similar in all three water bodies (fig. 18). However, densities of both bacteria varied over wide ranges, particularly in Dickinson Bayou.

Fecal coliform bacteria and *E. coli* bacteria densities grouped by flow condition in boxplots (fig. 19) show that the largest median and individual bacteria densities were in samples collected during high flow. High flows contain a larger proportion of surface runoff, which can transport bacteria.

Seasonal distribution of fecal coliform bacteria and *E. coli* bacteria is shown in figure 20. The median densities for both bacteria were largest during winter. The largest individual densities for both bacteria occurred during fall and winter. Seasonal distribution

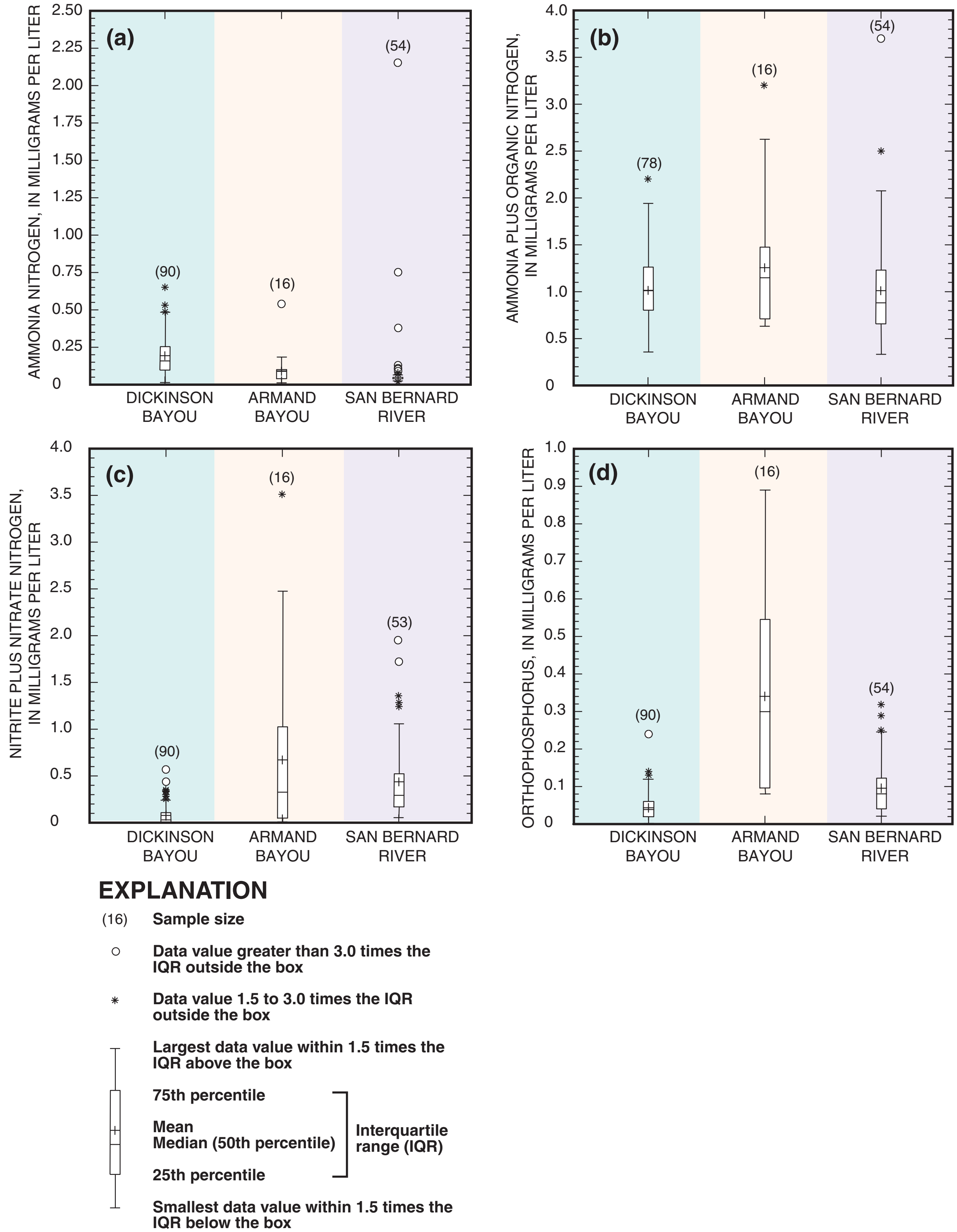

Figure 12. Distribution of periodically collected (a) ammonia nitrogen, (b) ammonia plus organic nitrogen, (c) nitrite plus nitrate nitrogen, and (d) orthophosphorus concentrations in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

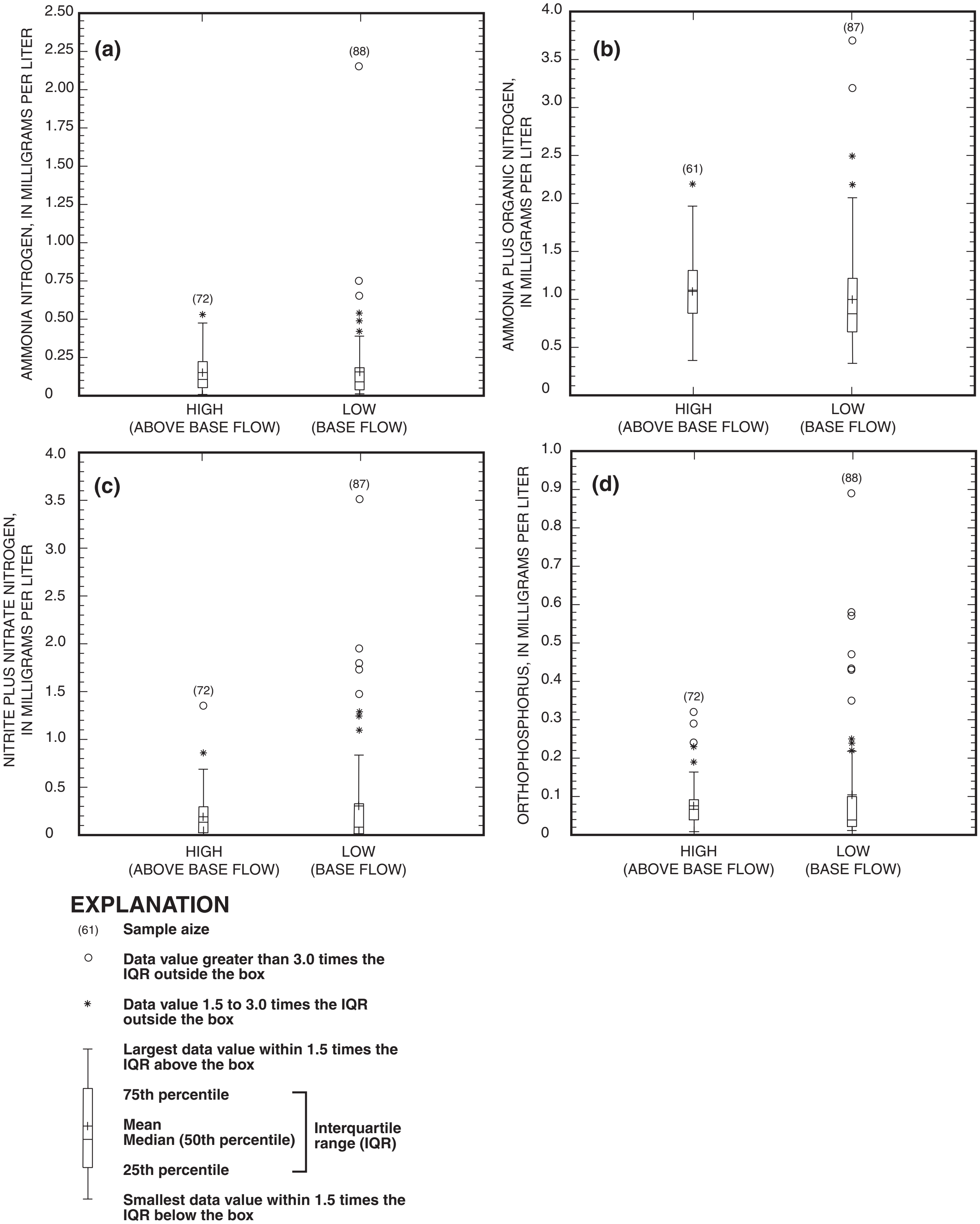

Figure 13. Distribution of periodically collected (a) ammonia nitrogen, (b) ammonia plus organic nitrogen, (c) nitrite plus nitrate nitrogen, and (d) orthophosphorus concentrations during high- and low-flow conditions in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

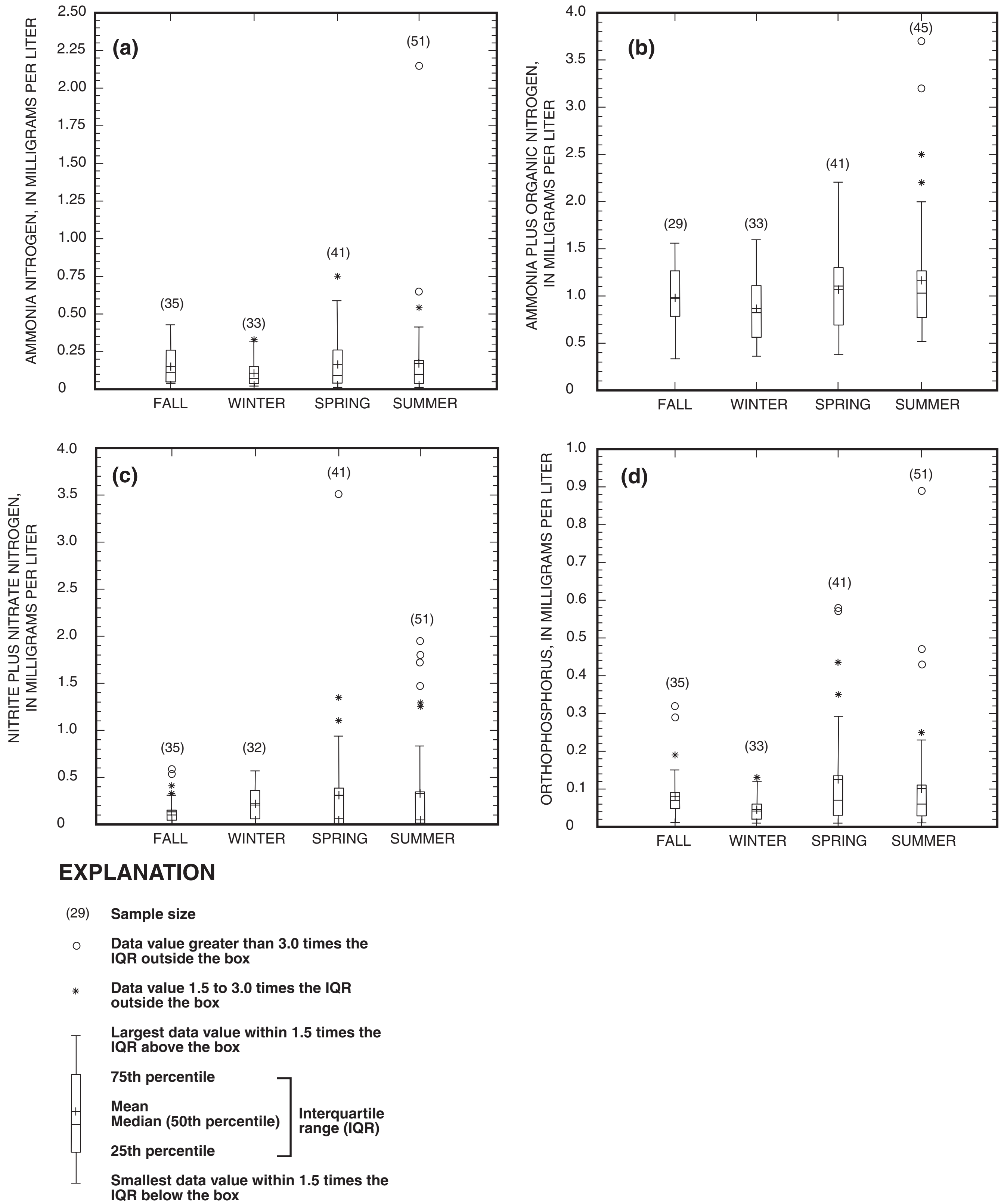

Figure 14. Seasonal distribution of periodically collected (a) ammonia nitrogen, (b) ammonia plus organic nitrogen, (c) nitrite plus nitrate nitrogen, and (d) orthophosphorus concentrations in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

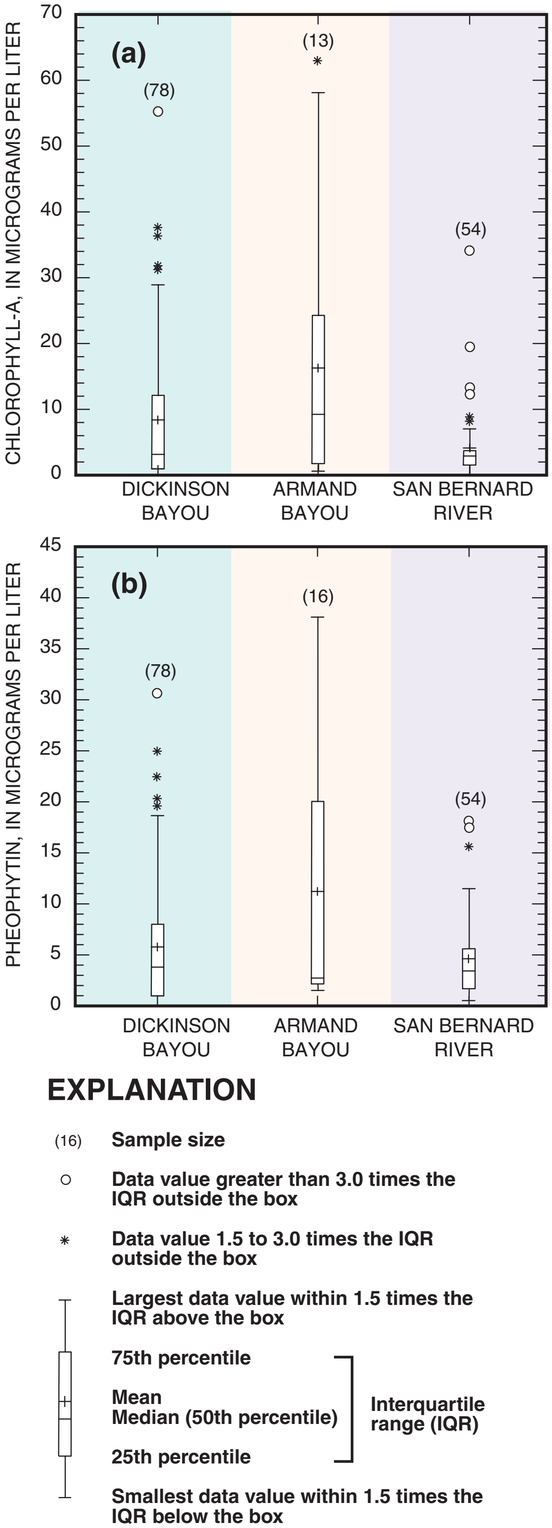

Figure 15. Distribution of periodically collected (a) chlorophyll-a and (b) pheophytin concentrations in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

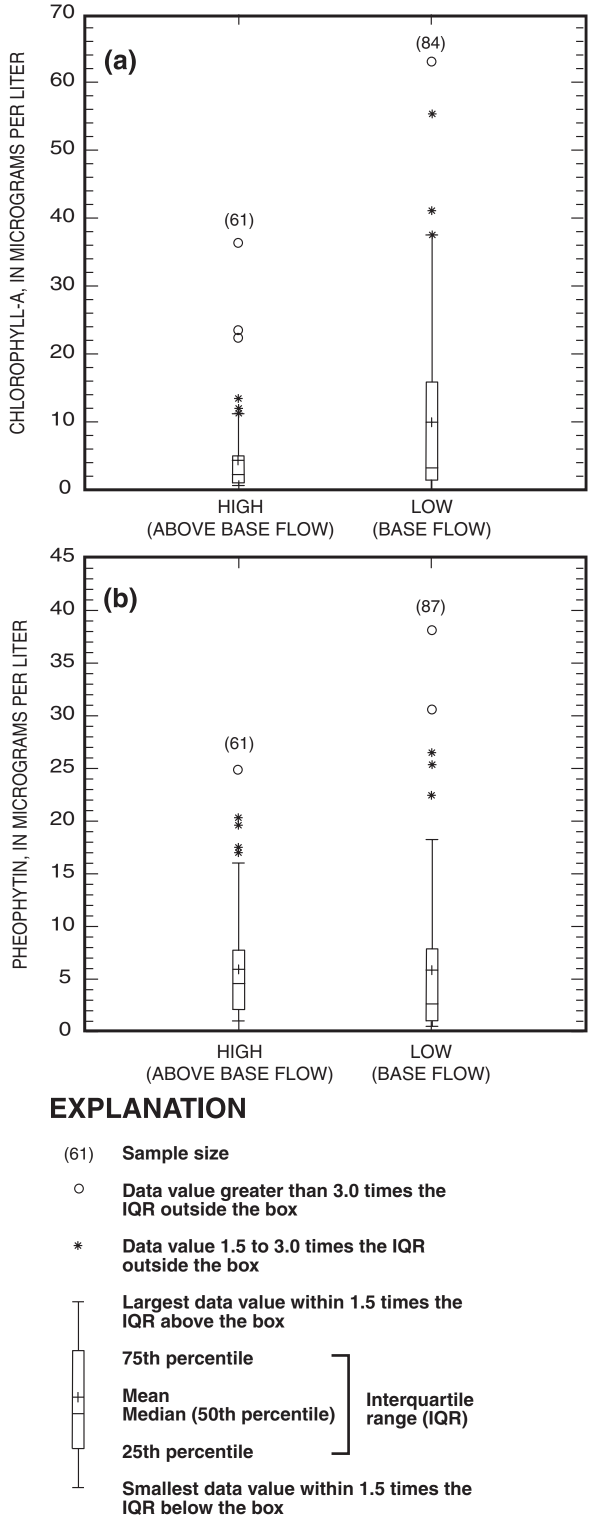

Figure 16. Distribution of periodically collected (a) chlorophyll-a and (b) pheophytin concentrations during high- and low-flow conditions in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

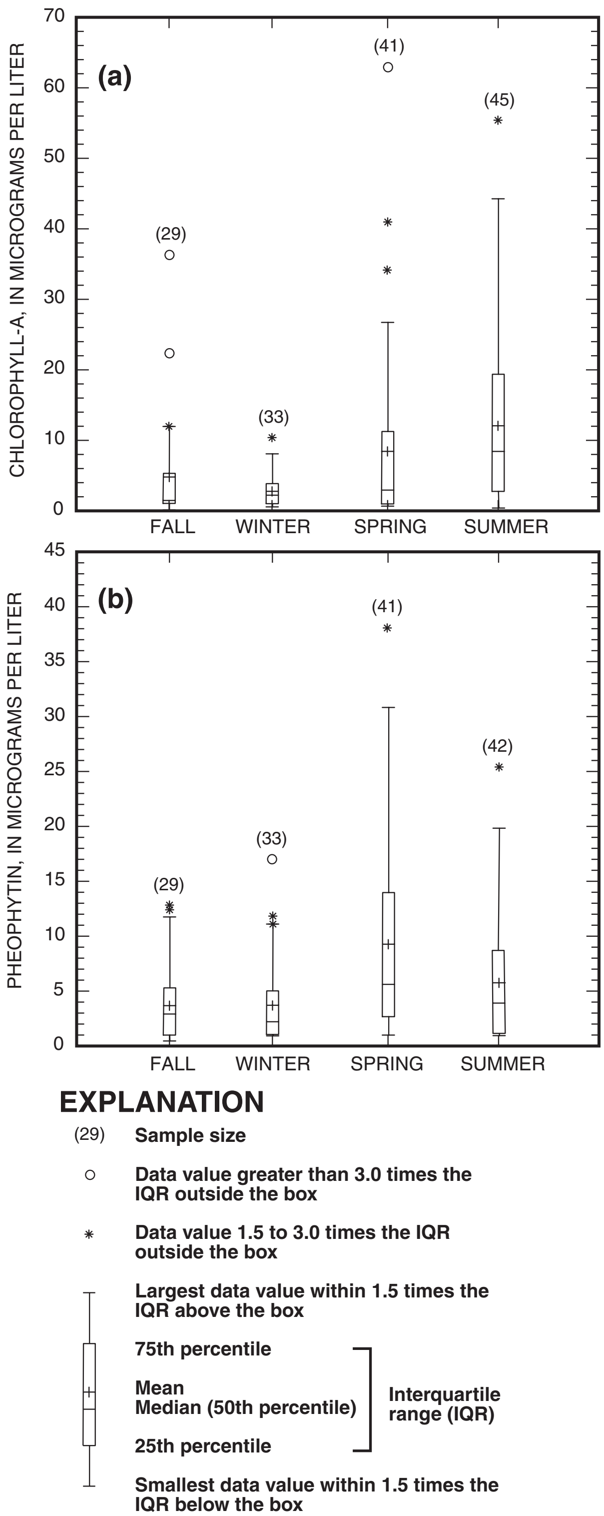

Figure 17. Seasonal distribution of periodically collected (a) chlorophyll-a and (b) pheophytin concentrations in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

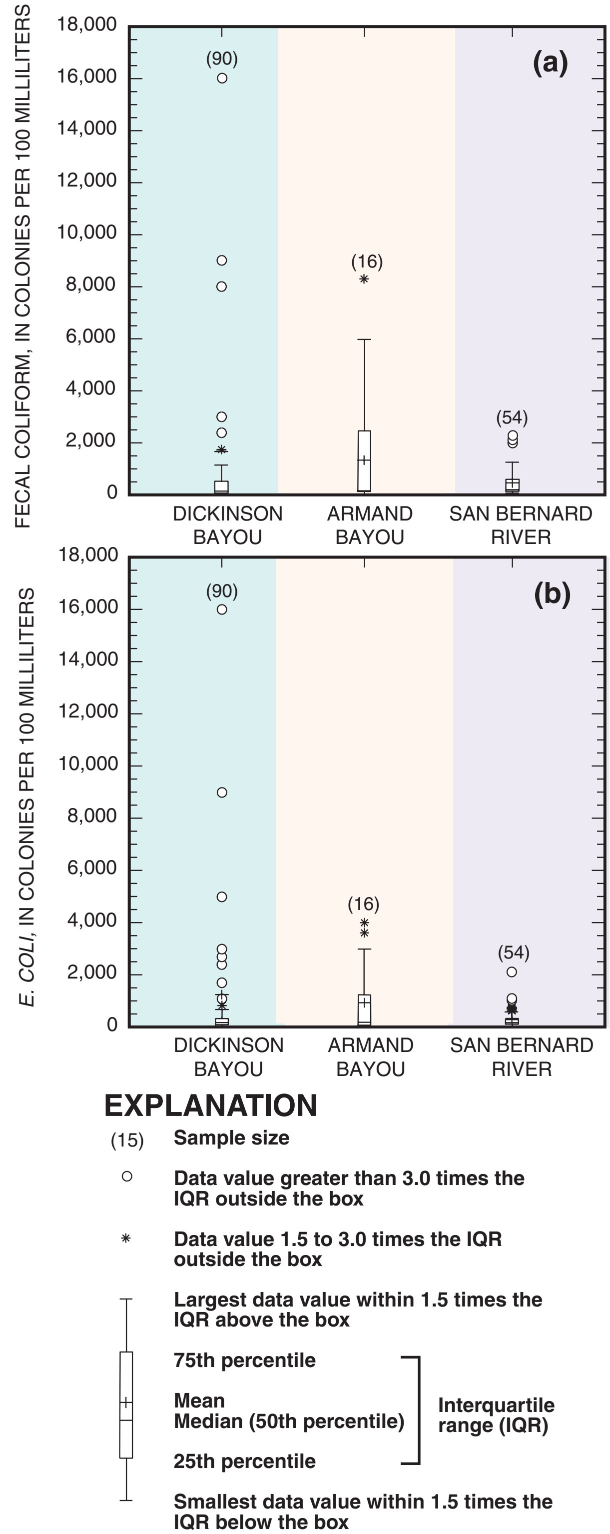

Figure 18. Distribution of periodically collected (a) fecal coliform bacteria and (b) *E. coli* bacteria densities in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

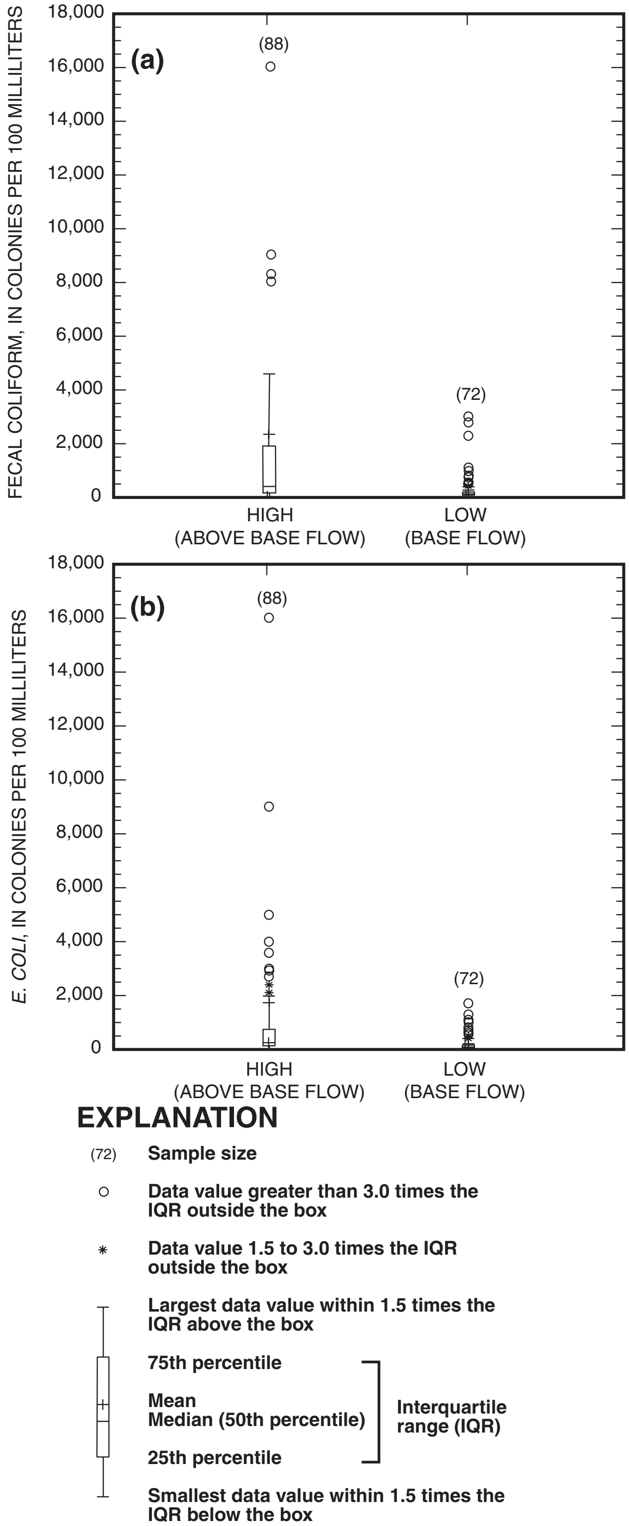

Figure 19. Distribution of periodically collected (a) fecal coliform bacteria and (b) *E. coli* bacteria densities during high- and low-flow conditions in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

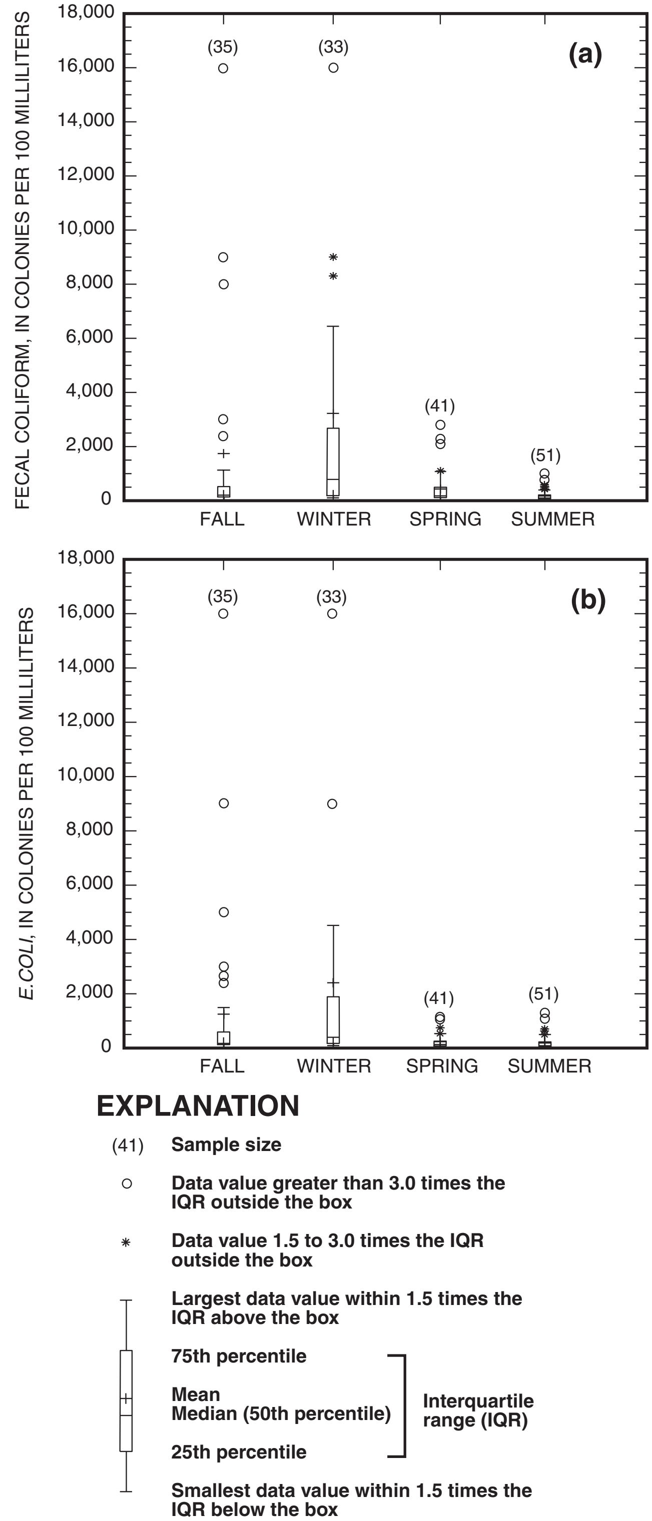

Figure 20. Seasonal distribution of periodically collected (a) fecal coliform bacteria and (b) *E. coli* bacteria densities in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

likely is related to flow conditions—the high-flow sampling events occurred during November and January.

Nutrient Yields

A constituent load for a stream is the product of a constituent concentration and streamflow and is the mass of a given constituent that is transported past a site on a stream during a specified period. The instantaneous load for a stream (Terrio, 1995) is computed as

$$LOAD(i) = FLOW(i) \times CONC(i) \times CF, \qquad (1)$$

where

LOAD = constituent load at time i, in pounds per day;

FLOW = discharge at time i, in cubic feet per second;

CONC = concentration of constituent at time i, in milligrams per liter; and

CF = conversion factor of 5.394.

Yield is a measure of the load-producing characteristics of a subbasin and is computed by dividing load by the area of the contributing subbasin,

$$YIELD = (LOAD) / (DA), \qquad (2)$$

where

YIELD = constituent yield, in pounds per day per square mile; and

DA = area of contributing subbasin, in square miles.

Constituent yield data can be used to make direct comparisons of constituent contributions between subbasins with different drainage areas, while minimizing differences associated with varying streamflow.

Figures 21–24 show distributions of constituent yields for samples collected at each sampling station in the three water bodies for ammonia nitrogen, ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus, respectively. The sampling stations are in downstream order in the boxplots. For most nutrients, the yield tended to increase with distance downstream, although this characteristic applied less to yields at San Bernard River sites than at Dickinson and Armand Bayou sites.

For each of the three water bodies, the yields were grouped by flow condition (low flow and high flow) (fig. 25). Constituent yields for the San Bernard River typically were less than constituent yields for Dickinson and Armand Bayous, during both low-flow and high-flow conditions. Also, median yields of ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus were larger for Armand Bayou than for the two other water bodies.

One possible explanation for larger yields for sites in Armand Bayou are anthropogenic effects related to land use in the watershed. Detailed maps of land use in the three water bodies were unavailable at the time of this report. However, a surrogate for land use in a given watershed is population density (number of people per square mile). Population density was computed for the drainage area upstream of each sampling site by overlaying watershed boundaries from 7.5-minute digital elevation model data (Texas Natural Resources Information System, 2003) on 2000 Census block data (U.S. Census Bureau, 2003) using GIS. The computed population density for the most downstream sampling site on the main stem of Armand Bayou (ARM03, fig. 2, table 1) was about 1,940 people per square mile; the population density for the most downstream sampling site in Dickinson Bayou (DCK05, fig. 2, table 1) was about 502 people per square mile. The computed population density for the most downstream sampling site in the San Bernard River (SANB03, fig. 3, table 1) was about 32 people per square mile. A larger population density indicates a more urbanized watershed. East and others (1998) found that nutrient concentrations in a stream that drained an urbanized watershed in Houston were appreciably larger than nutrient concentrations in Dickinson Bayou, which was less urbanized. Similarly, it is likely that some of the differences in the nutrient yields of Dickinson Bayou, Armand Bayou, and the San Bernard River are related to differences in land use in the respective drainage areas.

BIOLOGICAL DATA

To measure the status of in-stream biological resources, selected data were collected from each of the three water bodies to define fish and benthic macroinvertebrate community structure and to define stream-habitat conditions. In general, biological data for Dickinson and Armand Bayous are comparable because of their common hydrologic setting (tidally influenced, brackish water), and biological data for the San Bernard River are less comparable because they are from a riverine setting.

Fish Data

Fish taxa and individual counts of fish for Dickinson and Armand Bayous were presented previously in

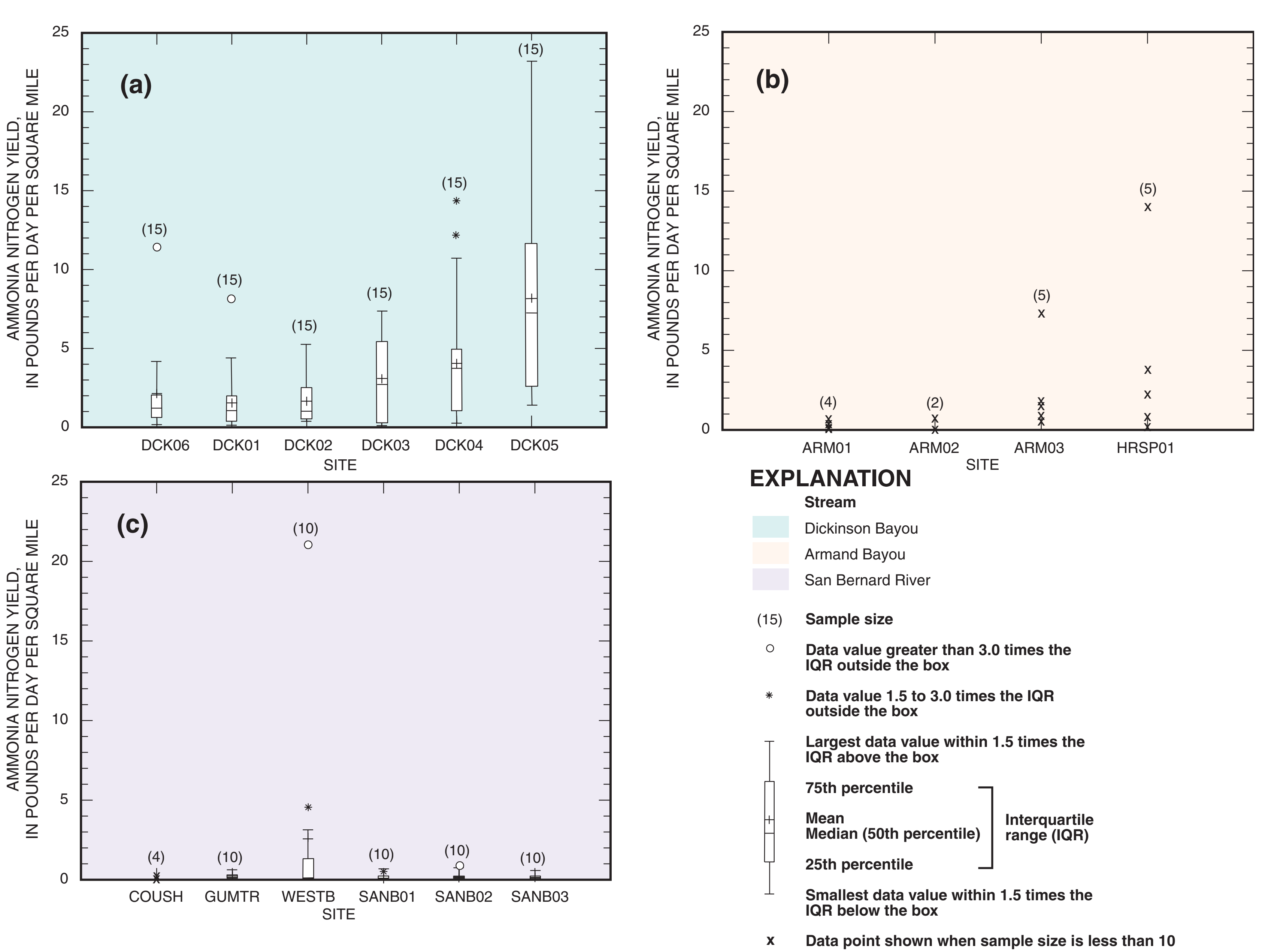

Figure 21. Yields of periodically collected ammonia nitrogen for selected sites in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, July 1999–September 2001.

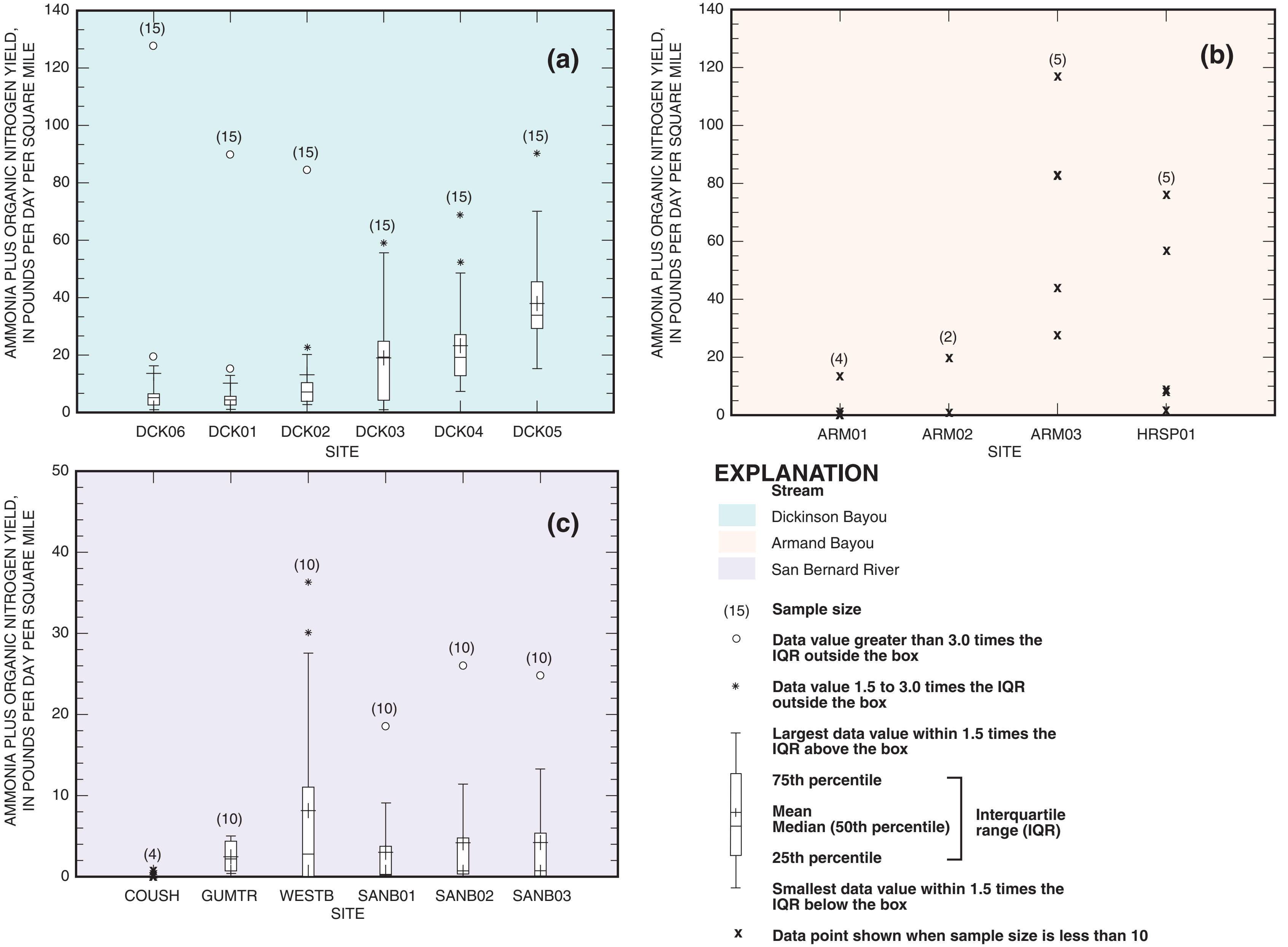

Figure 22. Yields of periodically collected ammonia plus organic nitrogen for selected sites in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, July 1999–September 2001.

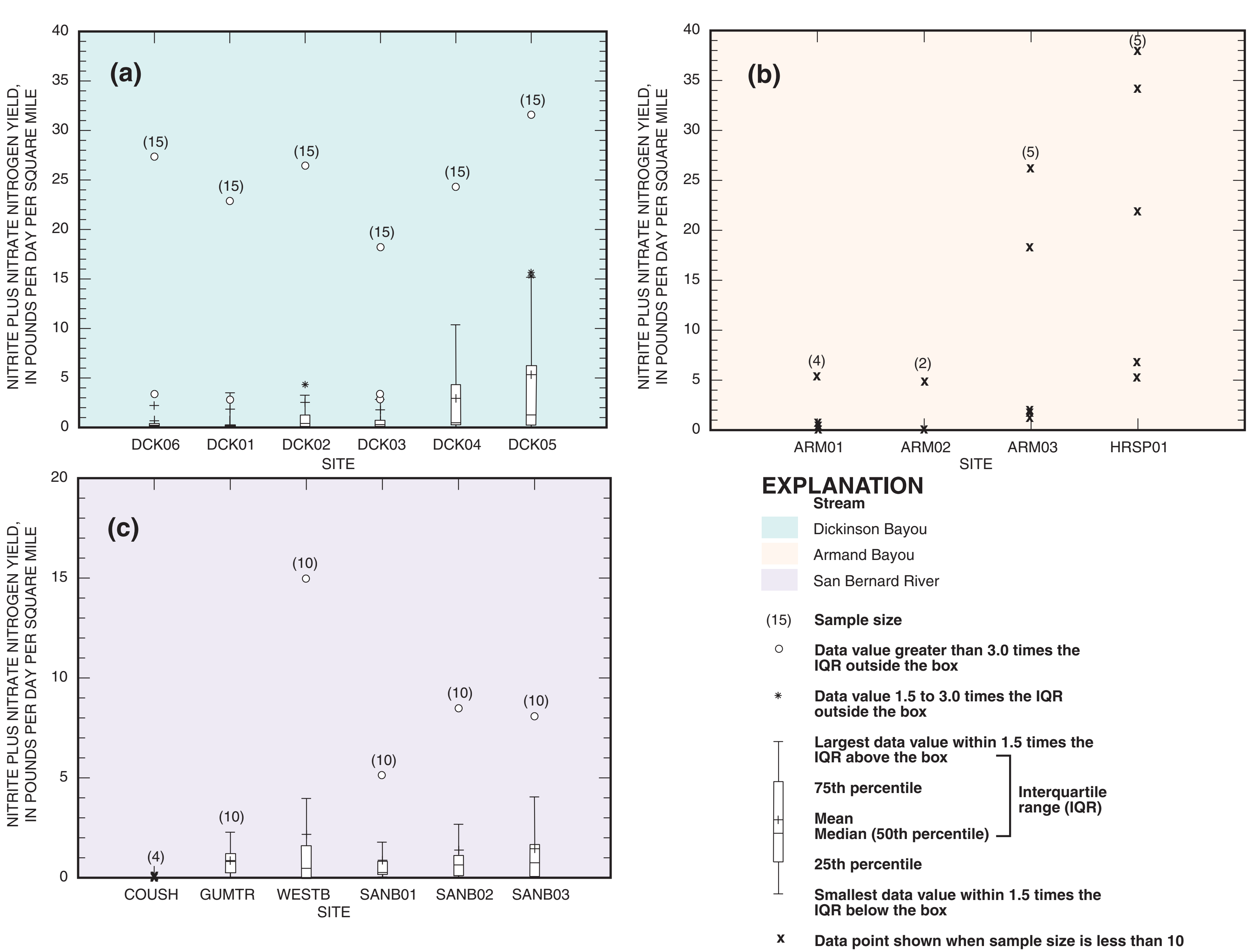

Figure 23. Yields of periodically collected nitrite plus nitrate nitrogen for selected sites in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, July 1999–September 2001.

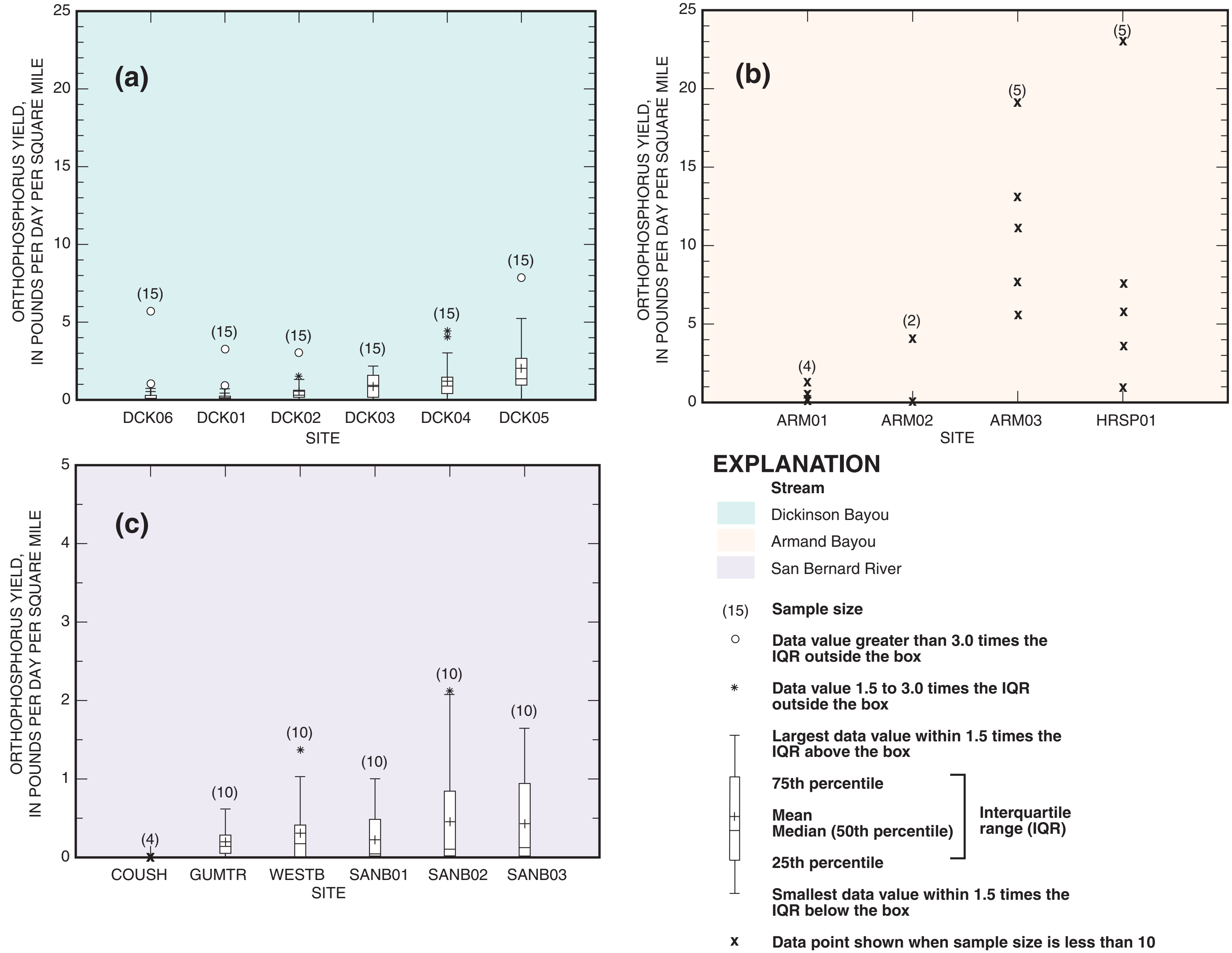

Figure 24. Yields of periodically collected orthophosphorus for selected sites in (a) Dickinson Bayou, (b) Armand Bayou, and (c) the San Bernard River, Texas Gulf Coastal Plain, July 1999–September 2001.

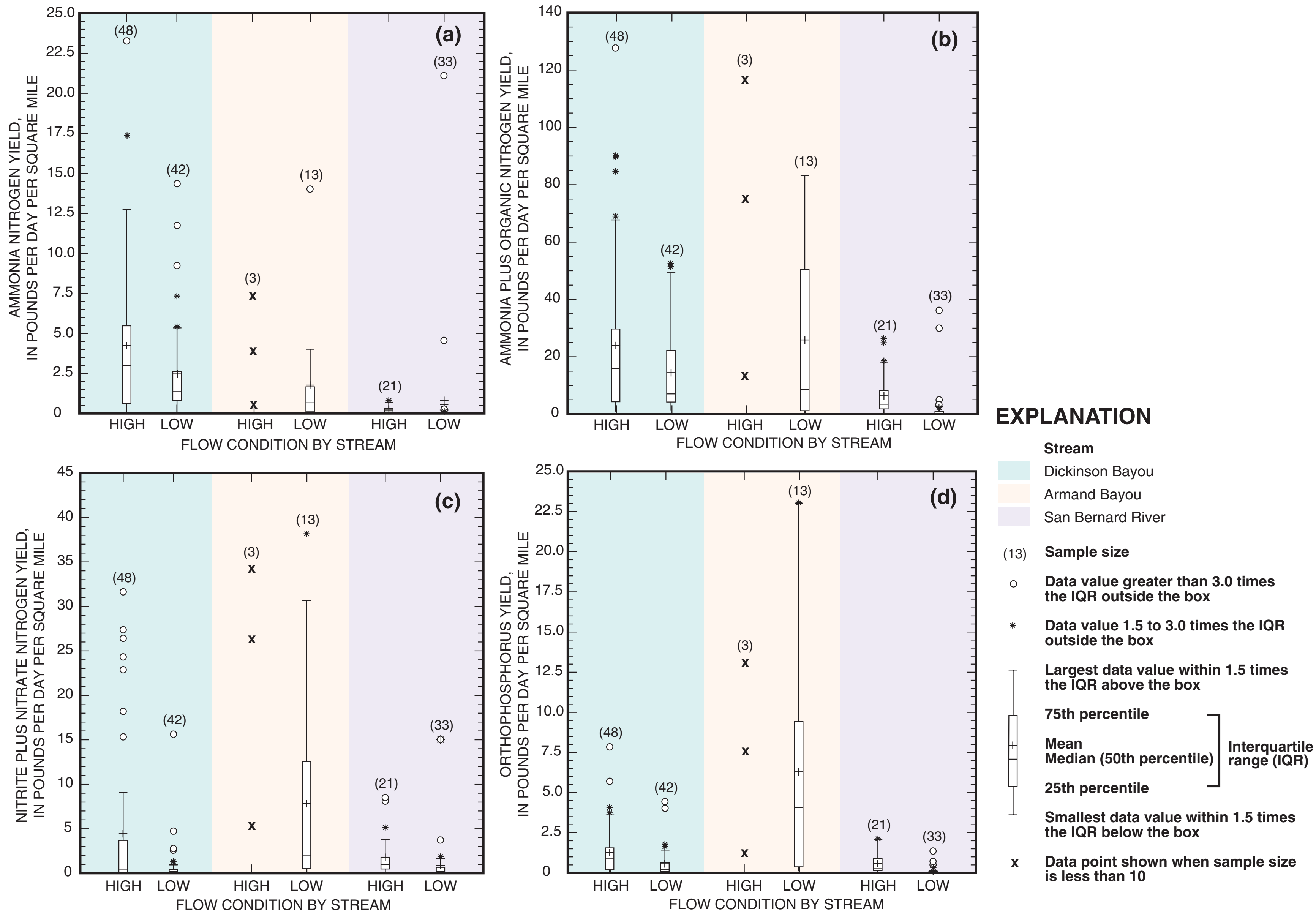

Figure 25. Yields of periodically collected (a) ammonia nitrogen, (b) ammonia plus organic nitrogen, (c) nitrite plus nitrate nitrogen, and (d) orthophosphorus during high-flow (above base flow) and low-flow (base flow) conditions in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002.

Hogan (2002). The distribution of species collected at each sampling reach in Dickinson Bayou and Armand Bayou are listed in tables 8 and 9 (at end of report), respectively. Examination of fish-survey data (Hogan, 2002, tables 3, 2) show that the largest numbers of fish and fish species were collected at the most downstream (brackish) main stem reach in both water bodies (DCK05 and ARM03, respectively).

Fish taxa and individual counts of fish for the San Bernard River are listed in table 10 (at end of report). The fish community structure in the two upstream main stem sites (SANB01 and SANB02) was similar to the community structure in the three tributaries. However, fewer individuals and species were collected at the most downstream main stem site (SANB03), which is opposite to the findings for Dickinson and Armand Bayous.

Fish community metrics were computed for each sampling site (table 11, at end of report). The metrics in the table that are not self-explanatory are Menhinick's richness index, defined as the ratio of the number of species to the square root of the sample size (Menhinick, 1964); and the Shannon-Wiener diversity index, defined as the product of the proportion of the total number of individuals of a given species and $\log_{10}$ of that proportion, quantity summed for all species collected (Brower and Zar, 1977).

Benthic Macroinvertebrate Data

Benthic macroinvertebrate data might provide better site-specific information about a site or reach than fish community data (Cuffney and others, 1993). Moring (2001) states that fish mobility tends to make determinations of accurate species composition and relative abundance more difficult.

Taxonomic classification of benthic macroinvertebrates and counts of individual taxa for sites in Dickinson and Armand Bayous were presented previously in Hogan (2002, tables 5, 4). These data, together with similar data for the San Bernard River (table 12, at end of report), were used to compute benthic macroinvertebrate community metrics (table 13, at end of report). The metrics in the table that are not self-explanatory (or previously defined) are Ephemeroptera Plecoptera Trichoptera (EPT) taxa richness, the sum of the number of families within the insect orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera); Hilsenhoff's biotic index, an index of pollution based on the presence of specific families of aquatic insects (Hilsenhoff, 1987); Margalef's richness index, a richness index equal to the number of species minus the reciprocal of $\log_e$ of the total number of individuals (Ludwig and Reynolds, 1988); Pielou's evenness index, defined as the Shannon-Wiener diversity index divided by the theoretical maximum of that index if all species in the sample were equally abundant (Menhinick, 1964); and Simpson's heterogeneity index, the probability that two individuals randomly drawn from all individuals collected at a site will be from the same species (Menhinick, 1964).

Habitat Data

Stream-habitat data collected from reaches in Dickinson and Armand Bayous were presented previously in Hogan (2002, table 6). Stream-habitat data from sites (reaches) in the San Bernard River are listed in table 14 (at end of report). The data in the table that might not be self-explanatory are sinuosity, the ratio of curvilinear reach length to linear reach length; mean channel width, the distance from the left high bank to the right high bank; and mean wetted channel width, the distance between the left edge of the water and the right edge of the water.

SUMMARY

During July 2000–September 2002, the USGS collected and analyzed site-specific hydrologic, water-quality, and biological data in Dickinson Bayou, Armand Bayou, and the San Bernard River in the Gulf Coastal Plain of Texas. Such data are of interest because segments of the three water bodies are on the State 303(d) list. Hydrologic data collected during the study consisted of precipitation, gage height, and streamflow. Precipitation data were obtained from two rain gages near the three water bodies. Rainfall distributions for the two sites were similar in terms of timing and magnitude, except during June 2001 when Tropical Storm Allison produced much more rainfall in the area of Dickinson and Armand Bayous than in the area of the San Bernard River. Tidally influenced gage height data were collected at continuous monitoring stations in Dickinson and Armand Bayous. The gage height timing and pattern were essentially the same at the two sites, but the magnitudes of tidal fluctuation were different. Streamflow data were computed for the continuous monitoring station in the San Bernard River.

Water temperature, specific conductance, pH, and dissolved oxygen were recorded at 15-minute intervals at one site in each of the three water bodies during

November 2000–August 2001. Seasonal variations in the water-quality properties for all three sites are typical of those observed at USGS stations along the Texas Gulf Coast. In particular, water temperature and dissolved oxygen are inversely related. Periods of smallest dissolved oxygen concentrations generally occurred in the summer months when water temperatures were highest.

Water-quality monitors were deployed at three depths at the Dickinson Bayou continuous monitoring station. Water temperature was slightly higher near the surface than at mid-depth and near bottom; specific conductance increased with depth; pH was less variable near the surface; and dissolved oxygen concentrations decreased with depth.

Selected water-quality properties and constituents in each of the three water bodies—principally nutrients, phytoplankton, and indicator bacteria—were collected periodically and measured by laboratory analysis. Samples were collected at six sites in Dickinson Bayou, four sites in Armand Bayou, and six sites in the San Bernard River. The median concentration of ammonia nitrogen was largest in Dickinson Bayou and smallest in the San Bernard River. Median concentrations of ammonia plus organic nitrogen, nitrite plus nitrate nitrogen, and orthophosphorus were largest in Armand Bayou. The median concentration of each of the four nutrients was larger for high-flow samples than for low-flow samples. However, the largest individual concentrations and ranges in concentration occurred in low-flow samples. Although no discernible pattern of seasonality was evident, the largest individual nutrient concentrations and ranges in concentration occurred during spring and summer (growing seasons).

Both median and individual concentrations of chlorophyll-a were largest for Armand Bayou. Median concentrations of pheophyton were similar for all three water bodies. The largest individual pheophyton concentrations were from Armand Bayou. Median concentrations of both chlorophyll-a and pheophytin in low-flow and high-flow samples were less than 5 µg/L. However, the largest individual concentrations of each were measured in low-flow samples. Similar to seasonally grouped nutrient concentrations, the largest individual concentrations of chlorophyll-a and pheophytin occurred in spring and summer.

Median densities of fecal coliform bacteria and *E. coli* bacteria were similar in all three water bodies. However, densities of both bacteria varied over wide ranges, particularly in Dickinson Bayou. The largest median and individual bacteria densities were in samples collected during high flow, primarily in fall and winter.

Yields of most nutrients tended to increase with distance downstream, although this characteristic applied less to yields at San Bernard River sites than to Dickinson Bayou and Armand Bayou sites. During both low-flow and high-flow conditions, yields for the San Bernard River were less than yields for Dickinson and Armand Bayous. Based on findings of a previous study in the area, it is likely that some of the differences in the nutrient yields of Dickinson Bayou, Armand Bayou, and the San Bernard River are related to differences in land use in the respective drainage areas.

Fish, benthic macroinvertebrate, and stream-habitat data were collected in each of the three water bodies. For Dickinson and Armand Bayous, the most individuals and species of fish were collected at the most downstream main stem site; for the San Bernard River, the fewest individuals and species were collected at the most downstream main stem site.

REFERENCES

Bower, J.E., and Zar, J.H., 1977, Field and laboratory methods for general ecology: Dubuque, Iowa, W.C. Brown, 193 p.

Coplin, L.S., and Lanning-Rush, Jennifer, 2002, Water-level altitudes 2002 and water-level changes in the Chicot, Evangeline, and Jasper aquifers and compaction 1973–2001 in the Chicot and Evangeline aquifers, Houston-Galveston Region, Texas: U.S. Geological Survey Open-File Report 02–134, 15 sheets, accessed March 6, 2003, at URL http://water.usgs.gov/pubs/of/ofr02-134/

Cuffney, T.F., Gurtz, M.E., and Meador, M.R., 1993, Methods for collecting benthic invertebrate samples as part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93–406, 66 p.

East, J.W., Paul, E.M., and Porter, S.D., 1998, Nutrient loading and selected water-quality and biological characteristics of Dickinson Bayou near Houston, Texas, 1995–97: U.S. Geological Survey Water-Resources Investigations Report 98–4012, 50 p.

Hilsenhoff, W.L., 1987, An improved biotic index of stream pollution: Great Lakes Entomology, v. 20, p. 31–39.

Hogan, J.L., 2002, Fish, benthic-macroinvertebrate, and stream-habitat data from two estuaries near Galveston Bay, Texas, 2000–2001: U.S. Geological Survey Open-File Report 02–024, 16 p.

Linam, G.W., and Kleinsasser, L.J., 1998, Classification of Texas freshwater fishes into trophic and tolerance groups: Texas Parks and Wildlife Department, River Studies Report 14, 6 p., accessed November 5, 2003, at URL http://water.usgs.gov/pubs/wri/wri014010/

Ludwig, J.A., and Reynolds, J.F., 1988, Statistical ecology—A primer of methods and computing: New York, Wiley, 337 p.

Menhinick, E.F., 1964, A comparison of some species-individuals diversity indices applied to samples of field insects: Ecology, v. 45, p. 859–861.

Moring, J.B., 2001, Influence of stream habitat and land use on benthic macroinvertebrate indicators of stream quality of selected above-tidal streams in the Houston-Galveston Area Council service area, Texas, 1997–98: U.S. Geological Survey Water-Resources Investigations Report 01–4010, 22 p., accessed November 5, 2003, at URL http://water.usgs.gov/pubs/wri/wri014010/

National Atmospheric Deposition Program (NRSP–3)/National Trends Network, 2003, Monthly data for site—TX10 (Attwater Prairie Chicken National Wildlife Refuge): NADP Program Office, Illinois State Water Survey, accessed March 6, 2003, at URL http://nadp.sws.uiuc.edu/nadpdata/monthlyRequest.asp?site=tx10

National Weather Service, 2003, National Weather Service forecast office, NWS HGX Office/League City climate data: accessed March 6, 2003, at URL: http://www.srh.noaa.gov/hgx/climate/hgx.htm

Parsons Engineering Science, Inc., 2000, Report for water quality and biological characterization of Armand Bayou, Houston, Texas: [Prepared for] Texas General Land Office GLO contract no. 99–123R and Texas Natural Resource Conservation Commission, 87 p.

Rantz, S.E., and others, 1982, Measurement and computation of streamflow—Volumes 1 and 2: U.S. Geological Survey Water-Supply Paper 2175, 631 p.

Simpson, Michael, 2001, Discharge measurements using a broad-band acoustic Doppler current profiler: U.S. Geological Survey Open-File Report 01–01, 123 p.

Texas Commission on Environmental Quality, 2002, Draft 2002 Texas 303(d) list (October 1, 2002): accessed August 27, 2003, at URL http://www.tnrcc.state.tx.us/water/quality/02_twqmar/02_categories/02_303d.pdf

______2003, Surface water assessment methodology: accessed June 2, 2003, at URL http://www.tnrcc.state.tx.us/water/quality/02_twqmar/02_305b/02_program_summary/12-swass.pdf

Terrio, P.J., 1995, Water-quality assessment of the Upper Illinois River Basin in Illinois, Indiana, and Wisconsin—Nutrients, dissolved oxygen, and fecal indicator bacteria in surface water, April 1987 through August 1990: U.S. Geological Survey Water-Resources Investigations Report 95–4005, 79 p.

Texas Natural Resource Conservation Commission, 1998, State of Texas 1998 Clean Water Act section 303(d) list (06/26/98): accessed August 27, 2003, at URL http://www.tnrcc.state.tx.us/water/quality/98_303D.pdf

______1999, Surface water quality monitoring procedures manual: Texas Natural Resource Conservation Commission, Water Quality Division, GI–252 [variously paged].

Texas Natural Resources Information System, 2003, Digital elevation models—Data availability and downloads: accessed April 3, 2003, at URL http://www.tnris.state.tx.us/stratmap/dem.htm

Texas Parks and Wildlife, 1997, GEMS—Armand Bayou Coastal Preserve & Nature Center: accessed April 10, 2000, at URL http://www.tpwd.state.tx.us/conserve/txgems/armandba/armandba.htm

Texas Water Commission, 1992, The State of Texas water quality inventory (11th ed.): Austin, Tex., LP 92–16, 671 p.

U.S. Census Bureau, 2003, United States census 2000: accessed April 1, 2003, at URL http://www.census.gov/main/www/cen2000.html

U.S. Geological Survey, 1997–present, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1–A7, accessed April 1, 2003, at URL http://water.usgs.gov/owq/FieldManual/

Wagner, R.J., Mattraw, H.C., Ritz, G.F., and Smith, B.A., 2000, Guidelines and standard procedures for continuous water-quality monitoring—Site selection, field operation, calibration, record computation, and reporting: U.S. Geological Survey Water-Resources Investigations Report 00–4252, 53 p.

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001

[Data provided by Galveston County Health District and Texas Commission on Environmental Quality; numbers in parentheses below property and constituent names are USGS National Water Quality Laboratory parameter codes]

0807764230 Dickinson Bayou at Ginger Rd, nr Alvin, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	1634	55	--	--	--	--	130	130	174	.01	.13	.63	.01
AUG													
17...	1035	-42	28.1	680	2.9	7.6	80	80	142	.06	.17	.84	.01
SEP													
12...	1042	29	28.0	1100	3.3	7.3	130	130	418	.01	.20	1.02	.01

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	<1.0	<1.0
AUG		
17...	<1.0	1.89
SEP		
12...	<1.0	<1.0

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

0807764230 Dickinson Bayou at Ginger Rd, nr Alvin, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
OCT													
10...	1106	37	14.3	1000	7.5	7.8	40	40	304	.02	.05	.51	.01
NOV													
14...	1032	149	12.0	260	8.6	7.5	8000	2700	6940	.13	.13	.75	.04
DEC													
12...	1102	57	9.7	700	8.5	7.8	300	300	336	.01	.17	.36	.01
JAN													
11...	1116	656	9.9	190	9.1	7.4	>16000	9000	7900	.24	.10	1.12	.05
FEB													
15...	1059	31	20.1	742	5.7	7.8	1700	400	134	.01	.12	.42	.01
MAR													
22...	1148	65	16.4	670	7.0	7.6	300	170	280	.01	.34	.58	.03
APR													
10...	1129	-56	24.0	700	2.2	7.4	80	80	192	.01	.11	.60	.03
MAY													
17...	1101	41	24.4	500	4.2	7.6	130	130	188	.01	.29	.58	.01
JUN													
19...	1053	-64	27.0	400	2.6	7.3	80	80	304	.01	.15	.78	.01
JUL													
12...	1041	-24	28.4	518	3.2	7.4	300	300	880	.08	.14	.52	.03
AUG													
16...	1049	20	27.8	669	1.6	7.5	300	300	720	.04	.33	.75	.02

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
OCT		
10...	<1.0	<1.0
NOV		
14...	1.17	<1.0
DEC		
12...	<1.0	<1.0
JAN		
11...	<1.0	<1.0
FEB		
15...	<1.0	<1.0
MAR		
22...	<1.0	6.83
APR		
10...	2.11	<1.0
MAY		
17...	<1.0	10.8
JUN		
19...	3.17	2.38
JUL		
12...	<1.0	9.30
AUG		
16...	<1.0	<1.0

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077643 Dickinson Bayou at Cemetary Rd nr Dickinson, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	1557	55	--	--	--	--	40	40	16	.01	.10	.66	.01
AUG													
17...	0753	-44	28.4	3800	4.7	7.5	80	80	8	.01	.07	.90	.03
SEP													
12...	0748	29	28.1	3500	0.3	7.1	220	220	228	.01	.29	1.21	.04

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	<1.0	<1.0
AUG		
17...	55.3	7.14
SEP		
12...	5.11	3.51

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077643 Dickinson Bayou at Cemetary Rd nr Dickinson, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS- CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER- ATURE WATER (DEG C) (00010)	SPE- CIFIC CON- DUCT- ANCE (US/CM) (00095)	OXYGEN, DIS- SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND- ARD UNITS) (00400)	COLI- FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO- COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO- GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO- GEN,AM- MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO- GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO- PHOS- PHATE, DIS- SOLVED (MG/L AS P) (00671)
OCT													
10...	0802	37	17.6	4700	1.6	7.1	20	20	300	.04	.05	.82	.04
NOV													
14...	0705	149	12.8	260	7.9	7.4	9000	5000	11800	.15	.13	.83	.05
DEC													
12...	0757	57	12.4	800	5.0	7.6	170	170	118	.01	.19	.46	.02
JAN													
11...	0752	656	9.9	200	9.0	7.4	>16000	>16000	4000	.28	.10	1.10	.04
FEB													
15...	0755	30	17.8	800	5.9	7.7	300	300	166	.01	.05	.36	.01
MAR													
22...	0739	65	15.7	680	6.7	7.5	230	230	186	.01	.36	.70	.03
APR													
10...	0812	-56	24.4	736	1.7	7.4	70	70	118	.01	.17	.72	.04
MAY													
17...	0755	41	24.5	500	3.6	7.5	130	130	180	.01	.23	.68	.01
JUN													
19...	0759	-64	27.7	400	1.2	7.1	500	500	62	.02	.25	.85	.02
JUL													
12...	0803	-24	28.7	566	2.0	7.2	230	230	240	.12	.14	.87	.03
AUG													
16...	0733	20	28.8	5140	1.3	7.2	70	70	70	.02	.22	.60	.04

Date	CHLOR-A PHYTO- PLANK- TON CHROMO FLUOROM (UG/L) (70953)	PHEO- PHYTIN A, PHYTO- PHYTON (UG/L) (62360)
OCT		
10...	<1.0	3.78
NOV		
14...	<1.0	<1.0
DEC		
12...	2.74	<1.0
JAN		
11...	6.42	7.05
FEB		
15...	<1.0	<1.0
MAR		
22...	<1.0	<1.0
APR		
10...	<1.0	<1.0
MAY		
17...	8.46	4.57
JUN		
19...	3.23	<1.0
JUL		
12...	10.2	<1.0
AUG		
16...	2.00	2.00

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077645 Dickinson Bayou nr Interstate 45, Dickinson, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	0905	90	--	--	--	--	20	20	2	.01	.10	1.01	.02
AUG													
17...	0733	-49	30.2	16400	0.9	7.2	40	40	4	.05	.09	1.03	.06
SEP													
12...	0731	81	30.1	18600	0.1	7.0	70	40	26	.05	.29	1.35	.08

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	3.20	14.0
AUG		
17...	17.3	<1.0
SEP		
12...	36.3	5.06

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077645 Dickinson Bayou nr Interstate 45, Dickinson, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
OCT													
10...	0736	32	18.2	17000	0.6	7.0	20	20	6	.02	.37	1.28	.08
NOV													
14...	0712	226	15.3	220	6.5	7.4	>16000	9000	25200	.20	.15	1.06	.07
DEC													
12...	0738	161	13.8	3800	5.6	7.6	500	500	186	.08	.23	.68	.03
JAN													
11...	0734	797	10.0	340	9.4	7.5	>16000	>16000	12700	.35	.07	1.12	.04
FEB													
15...	0731	78	16.7	910	4.6	7.6	220	220	70	.03	.14	.58	.02
MAR													
22...	0814	74	15.7	490	4.6	7.3	1100	1100	138	.06	.36	2.20	.05
APR													
10...	0747	-78	23.2	611	3.3	7.4	40	40	66	.10	.18	.94	.04
MAY													
17...	0733	92	25.4	1380	3.2	7.5	130	130	60	.30	.09	.82	.04
JUN													
19...	0735	-37	29.5	310	2.6	7.2	130	130	90	.11	.25	1.02	.02
JUL													
12...	0738	22	29.1	556	2.5	7.2	80	80	76	.04	.22	1.33	.03
AUG													
16...	0751	29	29.5	16110	2.8	7.4	230	230	126	.01	.20	1.00	.07

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
OCT		
10...	8.01	6.29
NOV		
14...	<1.0	12.8
DEC		
12...	<1.0	<1.0
JAN		
11...	<1.0	17.0
FEB		
15...	1.34	2.40
MAR		
22...	<1.0	6.47
APR		
10...	<1.0	6.82
MAY		
17...	<1.0	22.4
JUN		
19...	11.5	<1.0
JUL		
12...	7.99	<1.0
AUG		
16...	<1.0	2.00

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

0807764550 Dickinson Bayou upstream of Benson Bayou, Dickinson, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	1112	120	--	--	--	--	20	20	2	.01	.01	1.27	.01
AUG													
17...	0819	-264	30.9	19700	1.3	7.2	80	80	18	.01	.07	1.30	.05
SEP													
12...	0818	-237	30.3	22500	1.7	7.2	500	300	246	.03	.26	1.25	.09

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	31.2	16.3
AUG		
17...	37.6	7.56
SEP		
12...	2.80	7.66

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

0807764550 Dickinson Bayou upstream of Benson Bayou, Dickinson, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
OCT													
10...	0830	90	17.2	17100	2.0	7.0	220	170	60	.05	.43	1.43	.06
NOV													
14...	0738	301	15.6	500	5.8	7.4	>16000	>16000	18600	.14	.13	.98	.05
DEC													
12...	0822	292	14.1	4500	6.0	7.6	1100	1100	120	.12	.23	.82	.04
JAN													
11...	0821	905	9.9	4300	8.1	7.6	300	300	5200	.25	.10	.81	.03
FEB													
15...	0832	16	17.1	1000	5.6	7.6	800	800	172	.03	.11	.76	.02
MAR													
22...	0844	186	16.6	420	4.6	7.2	500	500	96	.01	.37	1.32	.07
APR													
10...	0844	-506	25.1	615	5.0	7.5	170	170	108	.01	.18	1.20	.04
MAY													
17...	0825	53	26.3	1900	5.8	7.7	80	80	18	.01	.49	1.00	.04
JUN													
19...	0821	-17	30.0	300	3.2	7.2	140	140	34	.01	.11	.98	.03
JUL													
12...	0828	51	30.2	1220	5.0	7.5	20	20	6	.01	.65	1.22	.14
AUG													
16...	0812	-280	30.3	17800	5.1	7.9	230	130	56	.03	.11	1.10	.07

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
OCT		
10...	5.29	5.14
NOV		
14...	<1.0	<1.0
DEC		
12...	3.14	<1.0
JAN		
11...	<1.0	3.84
FEB		
15...	5.34	3.38
MAR		
22...	<1.0	9.91
APR		
10...	18.8	<1.0
MAY		
17...	10.2	30.6
JUN		
19...	12.6	8.13
JUL		
12...	17.6	<1.0
AUG		
16...	3.00	3.00

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077647 Dickinson Bayou at State Hwy 3, Dickinson, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	1237	219	--	--	--	--	80	80	18	.01	.02	1.24	.01
AUG													
17...	0836	-307	31.1	22600	1.5	7.4	70	70	38	.02	.19	1.22	.04
SEP													
12...	0836	-183	30.0	24700	1.2	7.1	800	220	226	.01	.32	1.56	.11

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	31.8	6.64
AUG		
17...	12.0	6.58
SEP		
12...	11.2	5.47

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

08077647 Dickinson Bayou at State Hwy 3, Dickinson, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
OCT													
10...	0848	180	16.7	18600	3.7	7.2	110	80	36	.33	.05	1.31	.07
NOV													
14...	0752	485	15.8	900	5.8	7.4	3000	3000	3320	.13	.14	.85	.05
DEC													
12...	0833	344	14.1	4500	6.9	7.8	3000	1700	900	.19	.15	.84	.03
JAN													
11...	0838	1120	9.7	5600	8.1	7.7	9000	500	3000	.30	.15	.85	.05
FEB													
15...	0851	-200	17.5	1070	6.0	7.7	130	80	130	.03	.11	.86	.02
MAR													
22...	0905	178	16.9	450	4.9	7.2	300	300	120	.02	.40	1.49	.08
APR													
10...	0903	-472	24.5	825	5.1	7.6	130	80	14	.01	.42	1.53	.13
MAY													
17...	0844	171	26.9	2500	5.8	7.9	130	130	28	.01	.02	1.08	.03
JUN													
19...	0840	-161	30.2	400	3.8	7.2	80	80	14	.03	.16	1.10	.04
JUL													
12...	0848	113	30.5	1950	4.6	7.5	<20	<20	16	.04	.13	1.33	.05
AUG													
16...	0832	120	30.0	18500	5.3	7.9	90	90	24	.30	.19	.85	.06

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
OCT		
10...	12.0	2.79
NOV		
14...	<1.0	<1.0
DEC		
12...	10.4	<1.0
JAN		
11...	2.26	<1.0
FEB		
15...	5.61	11.8
MAR		
22...	<1.0	19.6
APR		
10...	15.8	<1.0
MAY		
17...	23.5	24.9
JUN		
19...	22.6	<1.0
JUL		
12...	19.2	8.06
AUG		
16...	3.00	2.00

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

0807764915 Dickinson Bayou below Gum Bayou, nr Texas City, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
JUL													
10...	1433	477	--	--	--	--	<20	<20	2	.01	.05	1.26	.01
AUG													
17...	0903	-500	30.5	26400	6.1	8.1	<20	<20	2	.01	.09	1.33	.04
SEP													
12...	0908	-336	29.2	28900	7.2	7.9	<20	<20	14	.01	.35	1.50	.07

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
JUL		
10...	25.6	9.26
AUG		
17...	15.6	9.98
SEP		
12...	22.4	7.44

Table 4. Periodically collected water-quality properties and constituents at six sites in Dickinson Bayou, July 2000–August 2001—Continued

0807764915 Dickinson Bayou below Gum Bayou, nr Texas City, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE INST. CUBIC FEET PER SECOND (00061)	TEMPER-ATURE WATER (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)
OCT													
10...	0911	-467	14.3	26000	6.6	7.5	<20	<20	16	.14	.43	1.15	.05
NOV													
14...	0806	895	14.2	2300	6.3	7.3	2400	2400	5900	.12	.22	.94	.04
DEC													
12...	0854	612	14.2	7500	7.4	7.9	800	800	96	.44	.33	.92	.05
JAN													
11...	0913	1600	10.0	10000	8.7	7.7	>16000	>16000	380	.34	.25	.97	.04
FEB													
15...	0915	-463	18.5	2400	7.5	7.8	140	140	26	.57	.27	1.26	.05
MAR													
22...	0938	564	16.9	680	6.5	7.3	500	500	60	.04	.53	1.39	.24
APR													
10...	0936	-691	24.4	3900	6.6	7.7	40	40	2	.01	.23	1.28	.10
MAY													
17...	0904	243	27.2	4200	7.6	8.4	40	40	2	.01	.13	1.09	.01
JUN													
19...	0902	-361	29.6	500	3.8	7.2	70	70	40	.06	.24	1.25	.06
JUL													
12...	0912	381	31.0	3200	7.6	8.2	<20	<20	32	.01	.08	1.38	.01
AUG													
16...	0857	410	29.0	21000	4.9	7.9	20	20	4	.01	.16	.95	.04

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)
OCT		
10...	<1.0	12.4
NOV		
14...	<1.0	1.25
DEC		
12...	4.41	<1.0
JAN		
11...	2.40	3.76
FEB		
15...	4.45	11.1
MAR		
22...	<1.0	20.3
APR		
10...	2.24	3.51
MAY		
17...	18.6	5.77
JUN		
19...	19.2	6.13
JUL		
12...	15.5	8.44
AUG		
16...	4.00	3.00

Remark codes used in this table:
< -- Less than
> -- Greater than

Table 5. Periodically collected water-quality properties and constituents at four sites in Armand Bayou, August 2000–July 2001

[Numbers in parentheses below property and constituent names are USGS National Water Quality Laboratory parameter codes]

293847095074501 Armand Bayou at Fairmont Pkwy, Pasadena, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)
JAN 17...	1411	21	247	7.6	12.6	760	9.0	85	5.8	2500	4000	4400	8000
MAR 22...	1140	4.0	772	7.7	17.4	760	6.6	69	1.5	2800	550	820	620
MAY 17...	1029	1.3	698	7.8	25.5	760	7.2	88	8.3	120	84	360	550
JUL 12...	0945	1.6	452	7.4	28.1	760	3.2	41	1.5	120	230	320	270

Date	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)
JAN 17...	.34	.011	.362	.04	1.3	.85	.59	.64	.90	.170	.117	.09	.267
MAR 22...	.20	.028	.228	.10	.90	.58	.54	.64	.68	.127	.098	.08	.239
MAY 17...	.32	.063	.386	<.046	1.1	--	--	.60	.68	.634	.62	.581	1.78
JUL 12...	--	E.004	.056	E.03	.68	--	--	.44	.63	.037	.135	.11	.343

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)
JAN 17...	4.7	2.2	565	575	76	4.3
MAR 22...	E.6	E1.7	343	350	40	.43
MAY 17...	1.6	2.7	436	441	18	.07
JUL 12...	4.1	2.6	270	273	4.0	.02

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 5. Periodically collected water-quality properties and constituents at four sites in Armand Bayou, August 2000–July 2001—Continued

293645095054601 Armand Bayou at Oil Field Rd, Pasadena, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	ALKA-LINITY WAT DIS FIX END FIELD CAC03 (MG/L) (39036)
AUG													
04...	1217	-76	320	7.9	31.0	760	5.8	78	4.9	100	54	116	300

Date	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)
AUG													
04...	.23	.056	.290	.04	1.5	1.2	.64	.68	1.2	.37	.29	.25	.754

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)
AUG				
04...	24.6	475	485	16

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)
MAY													
17...	1017	1.3	698	7.8	25.5	760	7.2	88	8.3	88	62	180	400

Date	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)
MAY													
17...	<.006	<.046	<.010	.60	1.5	.596	.398	.350	1.07	1.6	2.7	435	441

Date	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)
MAY		
17...	18	.06

Remark codes used in this report:
< -- Less than

Table 5. Periodically collected water-quality properties and constituents at four sites in Armand Bayou, August 2000–July 2001—Continued

293546095052701 Armand Bayou at Bay Area Blvd, Pasadena, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)
AUG 04...	1423	-169	11700	7.4	29.9	760	4.4	61	1.0	46	32	40	<.010

Date	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)
AUG 04...	<.050	<.02	.69	3.2	.90	.52	.43	1.31	8.4	968	997	21

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)
JAN 17...	1135	950	160	7.4	11.4	760	8.4	77	5.5	8300	3600	8700	13000
MAR 22...	1035	151	558	8.0	19.1	760	8.2	89	4.4	820	1000	750	620
MAY 17...	1115	285	995	8.8	27.9	760	7.1	91	8.9	32	48	110	430
JUL 12...	1225	238	554	8.5	31.2	760	4.5	61	4.4	580	700	250	520

Date	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)
JAN 17...	.16	.008	.180	.05	.98	.75	.54	.58	.80	.160	.112	.09	.270
MAR 22...	.72	.070	.792	<.04	2.0	--	--	.79	1.2	.42	.27	.24	.748
MAY 17...	--	<.006	.046	<.042	1.9	--	--	.59	1.9	.626	.403	.435	1.33
JUL 12...	.04	.012	.047	.04	1.3	1.2	.48	.53	1.2	.144	.25	.21	.647

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)
JAN 17...	.6	2.0	566	575	45	115
MAR 22...	41.1	38.1	1370	1400	47	19.2
MAY 17...	63.0	26.5	702	718	47	36.2
JUL 12...	19.9	25.4	469	481	95	61.0

Remark codes used in this report:
< -- Less than

Table 5. Periodically collected water-quality properties and constituents at four sites in Armand Bayou, August 2000–July 2001—Continued

08077630 Horsepen Bayou at Bay Area Blvd, Houston, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 1999 TO SEPTEMBER 2000

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)
AUG													
04...	0938	85	2000	7.9	30.2	760	5.5	74	3.6	110	54	116	1.29

Date	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)
AUG													
04...	.161	1.47	.54	3.7	1.7	.91	1.5	2.2	1.08	.98	.89	2.72	22.2

Date	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)
AUG				
04...	393	404	11	2.5

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STAND-ARD UNITS) (00400)	TEMPER-ATURE WATER (DEG C) (00010)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	E COLI, MTEC MF WATER (COL/ 100 ML) (31633)	FECAL STREP, KF STRP MF, WATER (COL/ 100 ML) (31673)	ENTERO-COCCI, ME MF, WATER (COL/ 100 ML) (31649)
JAN													
17...	1308	312	260	7.6	12.2	760	8.9	83	6.2	2900	2900	2300	7300
MAR													
22...	0912	.0	875	7.7	18.0	760	8.6	91	2.9	2300	24	1500	950
MAY													
17...	0934	20	275	8.5	27.8	760	10.5	134	6.2	130	110	120	150
JUL													
12...	1328	40	803	8.5	32.1	760	8.8	121	2.7	E160	1300	190	E310

Date	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	NITRO-GEN,AM-MONIA + ORGANIC DIS. (MG/L AS N) (00623)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	ORTHO-PHOS-PHATE, DIS-SOLVED (MG/L AS P) (00671)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4) (00660)
JAN													
17...	.33	.010	.360	.04	1.2	.76	.60	.65	.80	.140	.111	.08	.258
MAR													
22...	3.42	.093	3.51	.09	4.6	.97	.70	.79	1.1	.66	.60	.57	1.75
MAY													
17...	--	<.006	1.10	.131	2.5	1.3	.66	.79	1.4	.71	.61	.57	1.76
JUL													
12...	1.72	.073	1.80	.18	2.4	.46	.83	1.0	.65	.138	.60	.47	1.45

Table 5. Periodically collected water-quality properties and constituents at four sites in Armand Bayou, August 2000–July 2001—Continued

08077630 Horsepen Bayou at Bay Area Blvd, Houston, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	PHEO-PHYTIN A, PHYTO-PHYTON (UG/L) (62360)	PLANK-TON BIOMASS ASH WT (MG/L) (81353)	PLANK-TON BIOMASS DRY WT (MG/L) (81354)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)
JAN						
17...	2.1	1.5	570	581	27	22.7
MAR						
22...	10.1	14.6	462	473	15	--
MAY						
17...	23.2	13.3	678	686	16	.89
JUL						
12...	32.1	12.0	387	397	18	2.0

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002

[Numbers in parentheses below property and constituent names are USGS National Water Quality Laboratory parameter codes]

294036096165001 Coushatta Creek at Attwater Prairie Chicken National Wildlife Refuge, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/100 mL (31625)	E coli, m-TEC MF, water, col/100 mL (31633)	Fecal streptococci KF MF, col/100 mL (31673)	Enterococci, m-E MF, water, col/100 mL (31649)
JAN 18...	0950	4.2	103	6.8	7.6	760	11.2	94	2.8	750	750	650	825
MAR 20...	1457	.90	146	7.7	20.4	767	10.1	111	3.3	88	120	180	112
SEP 17...	0930	.32	218	6.9	25.8	765	6.2	76	1.4	453	620	550	300

Date	Nitrite water, fltrd, mg/L as N (00613)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)
JAN 18...	E.003	E.02	--	.66	--	--	.037	.02	.067	2.4	2.8	732	745
MAR 20...	E.004	<.04	.89	.53	.73	.056	.016	<.02	--	E2.9	E1.6	545	557
SEP 17...	<.006	<.04	--	.43	.79	.051	.006	<.02	--	5.3	4.0	457	464

Date	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
JAN 18...	189	2.1
MAR 20...	26	.06
SEP 17...	19	.02

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

294036096165001 Coushatta Creek at Attwater Prairie Chicken National Wildlife Refuge, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/100 mL (31625)	E coli, m-TEC MF, water, col/100 mL (31633)	Fecal streptococci KF MF, col/100 mL (31673)	Enterococci, m-E MF, water, col/100 mL (31649)
JAN													
29...	1016	.07	227	7.5	19.9	758	8.1	89	1.6	384	150	60	112

Date	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)
JAN													
29...	<.008	<.050	<.04	.45	.61	.033	.007	<.02	2.8	2.6	352	360	20

Date	Suspended sediment load, tons/d (80155)
JAN	
29...	.00

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

293211096110301 West Bernard Creek at CR 252, nr East Bernard, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
JAN 18...	1045	237	133	6.8	8.1	760	9.9	84	4.0	2300	2100	1860	2300
MAR 20...	1350	9.2	294	7.2	14.3	767	9.2	89	2.6	600	750	975	675
MAY 15...	0944	8.3	519	7.6	23.7	763	6.3	75	3.8	1480	1000	775	750
JUL 10...	1017	16	514	7.9	27.5	760	5.9	75	1.0	442	1600	875	147
SEP 17...	1055	4.3	148	7.4	25.7	765	5.8	71	1.5	525	700	1000	775

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
JAN 18...	.11	.006	--	.04	--	--	.66	.70	--	--	.103	.08	.239
MAR 20...	.21	.018	--	.09	1.5	1.2	.79	.89	1.3	.26	.058	.04	.113
MAY 15...	.36	.070	--	.05	2.0	1.5	.90	.95	1.6	.30	.126	.09	.288
JUL 10...	.18	.008	.191	E.03	1.1	--	--	.49	.86	.050	.092	.08	.245
SEP 17...	.37	.035	.413	.04	1.7	1.3	.84	.89	1.3	.29	.174	.14	.417

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
JAN 18...	3.1	5.4	951	967	82	52
MAR 20...	4.8	11.1	1420	1450	65	1.6
MAY 15...	13.4	17.5	727	740	86	1.9
JUL 10...	3.0	5.6	320	326	76	3.3
SEP 17...	3.5	3.6	2840	2840	67	.79

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

293211096110301 West Bernard Creek at CR 252, nr East Bernard, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/100 mL (31625)	E coli, m-TEC MF, water, col/100 mL (31633)	Fecal streptococci KF MF, col/100 mL (31673)	Enterococci, m-E MF, water, col/100 mL (31649)
NOV													
13...	1325	.07	1030	7.5	19.2	760	4.1	44	2.2	112	140	379	293
JAN													
29...	1203	.29	2070	7.7	18.5	758	7.6	82	1.2	153	120	273	310
MAR													
12...	1300	.21	2360	8.2	16.9	760	10.0	105	2.0	153	28	360	--
MAY													
29...	1311	49	561	7.5	25.0	759	4.7	57	7.1	173	96	575	--
AUG													
28...	1052	40	450	7.2	27.8	765	2.6	34	9.0	750	260	--	2300

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
NOV													
13...	--	E.007	<.10	.05	.95	.83	.75	.81	.88	.199	.139	<.02	--
JAN													
29...	--	E.006	.095	.05	.64	.50	.43	.48	.55	.062	.036	.02	.058
MAR													
12...	--	<.008	<.050	<.04	--	--	--	.41	.85	.19	.021	<.02	--
MAY													
29...	.97	.259	1.25	.38	3.8	2.1	1.7	2.1	2.5	.188	.088	.06	.193
AUG													
28...	.21	.130	.380	2.15	4.0	1.5	1.4	3.6	3.7	.34	.193	.14	.420

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
NOV						
13...	1.5	.8	282	287	5	.01
JAN						
29...	1.8	1.7	330	335	12	.01
MAR						
12...	2.2	1.8	--	--	20	.01
MAY						
29...	8.9	10.8	356	364	84	11
AUG						
28...	E5.5	E6.3	E432	E446	37	4.0

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

293123096073001 Gum Tree Branch at CR 252, nr East Bernard, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instan- taneous dis- charge, cfs (00061)	Specif. conduc- tance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temper- ature, water, deg C (00010)	Baro- metric pres- sure, mm Hg (00025)	Dis- solved oxygen, mg/L (00300)	Dis- solved oxygen, percent of sat- uration (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coli- form, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal strep- tococci KF MF, col/ 100 mL (31673)	Entero- cocci, m-E MF, water, col/ 100 mL (31649)
JAN 18...	1131	9.3	175	6.9	8.7	760	9.6	82	4.4	700	720	1050	1220
MAR 20...	1255	25	538	7.3	14.2	767	8.3	80	3.9	575	E34k	340	320
MAY 15...	1119	16	695	7.4	23.3	763	5.1	59	2.6	213	400	300	340
JUL 10...	1140	44	544	7.9	27.8	760	5.4	69	1.4	525	410	533	207
SEP 17...	1202	28	447	7.2	25.8	765	4.0	49	2.5	E280k	E340k	650	900

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitro- gen, water, unfltrd mg/L (00600)	Organic nitro- gen, water, unfltrd mg/L (00605)	Organic nitro- gen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phos- phorus, water, unfltrd mg/L (00665)	Phos- phorus, water, fltrd, mg/L (00666)	Ortho- phos- phate, water, fltrd, mg/L as P (00671)	Ortho- phos- phate, water, fltrd, mg/L (00660)
JAN 18...	.22	.006	--	E.04	--	--	--	.62	--	--	.101	.08	.236
MAR 20...	.22	.064	--	.12	1.2	.78	1.2	1.3	.90	.067	.167	.13	.392
MAY 15...	.37	.025	--	.06	1.6	1.1	.72	.77	1.2	.21	.113	.08	.251
JUL 10...	.26	.008	.273	.04	1.0	.68	.49	.53	.73	.039	.086	.07	.218
SEP 17...	.45	.052	.530	.09	1.6	.99	1.0	1.1	1.1	.26	.188	.14	.420

Date	Chloro- phyll a phyto- plank- ton, fluoro, ug/L (70953)	Pheo- phytin a, phyto- plank- ton, ug/L (62360)	Biomass plank- ton, ash wgt mg/L (81353)	Biomass plank- ton, dry wgt mg/L (81354)	Sus- pended sedi- ment concen- tration mg/L (80154)	Sus- pended sedi- ment load, tons/d (80155)
JAN 18...	5.0	6.4	942	961	104	2.6
MAR 20...	3.5	8.3	987	1020	105	7.1
MAY 15...	3.8	5.6	690	697	66	2.8
JUL 10...	2.1	3.2	344	352	66	7.8
SEP 17...	1.9	2.9	334	342	67	5.1

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

293123096073001 Gum Tree Branch at CR 252, nr East Bernard, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instan-taneous dis-charge, cfs (00061)	Specif. conduc-tance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temper-ature, water, deg C (00010)	Baro-metric pres-sure, mm Hg (00025)	Dis-solved oxygen, mg/L (00300)	Dis-solved oxygen, percent of sat-uration (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coli-form, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal strep-tococci KF MF, col/ 100 mL (31673)	Entero-cocci, m-E MF, water, col/ 100 mL (31649)
NOV													
13...	1240	8.2	1620	7.6	19.7	760	4.9	54	1.0	120	210	140	108
JAN													
29...	1330	6.8	1640	7.6	19.6	758	7.1	78	1.1	147	170	193	213
MAR													
12...	1446	6.8	1700	7.7	18.5	760	8.0	86	1.7	167	84	68	--
MAY													
29...	1152	12	759	7.7	25.2	759	6.7	82	4.0	200	84	236	--
AUG													
28...	1001	8.7	454	7.4	26.8	764	4.7	59	5.5	1000	620	--	4200

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitro-gen, water, unfltrd mg/L (00600)	Organic nitro-gen, water, unfltrd mg/L (00605)	Organic nitro-gen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phos-phorus, water, unfltrd mg/L (00665)	Phos-phorus, water, fltrd, mg/L (00666)	Ortho-phos-phate, water, fltrd, mg/L as P (00671)	Ortho-phos-phate, water, fltrd, mg/L (00660)
NOV													
13...	--	<.008	.13	<.04	.75	--	--	.23	.62	.150	.069	.05	.153
JAN													
29...	--	E.004	.175	.05	.66	.44	.27	.32	.48	.088	.048	.03	.104
MAR													
12...	--	<.008	.052	E.02	.46	--	--	.23	.40	.075	.035	.02	.067
MAY													
29...	.27	.034	.340	E.03	1.6	--	--	.55	1.2	.24	.088	.07	.199
AUG													
28...	.47	.217	.720	.13	2.2	1.4	1.1	1.2	1.5	.29	.155	.12	.356

Date	Chloro-phyll a phyto-plank-ton, fluoro, ug/L (70953)	Pheo-phytin a, phyto-plank-ton, ug/L (62360)	Biomass plank-ton, ash wgt mg/L (81353)	Biomass plank-ton, dry wgt mg/L (81354)	Sus-pended sedi-ment concen-tration mg/L (80154)	Sus-pended sedi-ment load, tons/d (80155)
NOV						
13...	2.9	2.9	266	272	119	2.7
JAN						
29...	2.2	2.0	299	306	49	.90
MAR						
12...	2.7	4.8	256	263	21	.38
MAY						
29...	19.5	18.1	360	368	131	4.2
AUG						
28...	E3.7	E9.3	E713	E741	76	1.8

Remark codes used in this report:
< -- Less than
E -- Estimated value

Value qualifier codes used in this report:
k -- Counts outside acceptable range

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

292939096014001 San Bernard River at FM 2919 nr Kendleton, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
JAN													
18...	1337	985	103	6.7	9.8	760	9.3	83	3.7	2000	250	1780	1800
MAR													
20...	1120	481	89	6.7	13.8	767	7.7	74	4.6	200	110	280	320
MAY													
15...	1337	20	238	7.1	23.6	763	3.6	42	2.3	273	260	187	180
JUL													
10...	1340	29	382	7.8	27.8	760	4.7	61	.6	193	290	233	300
SEP													
18...	1022	169	147	7.0	26.3	765	4.3	53	1.9	750	600	600	880

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
JAN													
18...	.35	.007	--	.04	--	--	.64	.69	--	--	.107	.07	.221
MAR													
20...	.15	.023	--	.07	1.3	1.1	.63	.70	1.1	.23	.103	.08	.233
MAY													
15...	.63	.088	--	.10	1.7	.91	.59	.69	1.0	.26	.181	.14	.432
JUL													
10...	.44	.018	.463	.07	1.1	.61	.41	.48	.68	.041	.118	.11	.331
SEP													
18...	.20	.018	.244	.06	1.3	.95	.77	.82	1.0	.38	.23	.19	.589

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
JAN						
18...	3.3	4.6	963	981	107	285
MAR						
20...	3.6	3.6	707	724	41	53
MAY						
15...	8.2	7.7	464	471	10	.53
JUL						
10...	.7	1.7	310	315	24	1.9
SEP						
18...	3.7	5.7	302	306	23	10

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

292939096014001 San Bernard River at FM 2919 nr Kendleton, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
NOV													
13...	1050	11	184	7.1	19.0	760	5.2	56	.8	96	130	160	193
MAR													
13...	1230	9.4	218	7.3	17.3	761	8.9	93	1.8	84	40	70	--
MAY													
31...	0856	27	481	6.4	23.8	759	5.6	67	1.6	132	92	900	--
AUG													
28...	1148	18	247	7.2	27.4	764	4.1	52	3.2	340	100	--	273

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)
NOV													
13...	--	E.004	.59	<.04	1.1	.35	.50	.168	.112	.09	.282	E.1	E.5
MAR													
13...	--	<.008	.380	<.04	.83	.34	.46	.104	.065	.05	.153	.7	2.4
MAY													
31...	1.67	.018	1.72	<.04	2.5	.72	.77	.175	.136	.11	.343	1.4	3.0
AUG													
28...	1.19	.065	1.28	E.04	2.1	.68	.85	.38	.26	.25	.754	E.4	E1.3

Date	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
NOV				
13...	288	294	9	.27
MAR				
13...	264	269	4	.10
MAY				
31...	340	346	9	.66
AUG				
28...	E258	E263	8	.40

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

08117500 San Bernard River nr Boling, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
JAN 19...	1242	2190	155	7.3	8.2	769	10.2	86	2.4	2300	680	4400	5400
MAR 21...	1246	1060	102	7.2	14.8	770	7.0	69	2.0	800	240	925	800
MAY 16...	1226	116	350	7.7	24.1	763	6.9	82	1.6	140	240	233	750
JUL 11...	1545	95	493	7.8	29.2	760	6.3	83	1.2	56	140	510	474
SEP 19...	1143	522	167	7.2	26.5	764	4.4	55	1.1	E240k	--	575	750

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
JAN 19...	.51	.007	--	.04	1.9	1.4	.62	.67	1.4	.105	.171	.13	.399
MAR 21...	.19	.009	--	E.03	1.3	--	--	.66	1.1	--	.108	.08	.258
MAY 16...	.82	.024	--	<.04	1.9	--	--	.67	1.1	.29	.188	.16	.484
JUL 11...	--	E.005	.305	<.04	.99	--	--	.44	.69	.058	.120	.10	.300
SEP 19...	--	.011	.245	.04	1.1	.85	.78	.82	.89	.45	.40	.32	.993

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
JAN 19...	2.0	8.0	1470	1500	192	1140
MAR 21...	3.4	4.5	1390	1420	62	177
MAY 16...	1.9	4.2	736	749	62	19
JUL 11...	3.0	3.2	303	310	60	15
SEP 19...	1.2	1.9	457	467	46	65

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

08117500 San Bernard River nr Boling, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
NOV													
14...	1328	28	568	7.7	20.2	760	6.2	68	1.0	100	230	193	80
JAN													
30...	1209	67	492	7.7	18.9	761	7.8	84	.9	133	80	108	153
MAR													
13...	1418	24	848	8.1	18.6	761	10.2	110	3.8	147	48	40	--
MAY													
31...	1027	90	598	6.8	24.3	759	6.6	79	1.8	160	88	240	--
AUG													
29...	1032	98	294	7.5	28.1	765	4.9	62	2.5	56	350	--	160

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
NOV													
14...	--	<.008	<.10	<.04	.57	--	--	.40	.50	.160	.121	.10	.313
JAN													
30...	--	<.008	--	E.03	.92	--	--	.40	.53	.109	.061	.04	.138
MAR													
13...	.35	.041	.425	.75	2.5	1.3	.75	1.5	2.0	.21	.130	.10	.300
MAY													
31...	--	E.005	1.29	<.04	2.1	--	--	.65	.78	.150	.101	.08	.245
AUG													
29...	.61	.091	.715	E.03	1.9	--	--	.94	1.2	.35	.24	.22	.671

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
NOV						
14...	.8	1.1	278	284	15	1.1
JAN						
30...	1.4	1.6	320	327	39	7.1
MAR						
13...	34.1	15.6	464	477	31	2.0
MAY						
31...	3.7	4.6	352	360	43	10
AUG						
29...	E1.1	E1.7	E484	E496	42	11

Remark codes used in this report:
< -- Less than
E -- Estimated value

Value qualifier codes used in this report:
k -- Counts outside acceptable range

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

290935095455601 San Bernard River at FM 1301 nr East Columbia, TX

WATER-QUALITY DATA, WATER YEAR OCTOBER 2000 TO SEPTEMBER 2001

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
JAN 19...	1428	2510	181	7.6	8.7	769	10.4	89	2.4	775	250	2060	2200
MAR 21...	1110	1380	107	7.4	14.0	765	7.6	73	2.0	600	210	260	373
MAY 16...	1115	174	223	7.6	23.4	763	6.9	81	2.2	500	150	400	280
JUL 11...	1350	59	648	7.8	28.4	760	8.3	107	1.6	147	210	333	437
SEP 19...	1041	684	160	7.3	26.1	764	5.4	67	1.8	160	2900	525	500

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Organic nitrogen, water, unfltrd mg/L (00605)	Organic nitrogen, water, fltrd, mg/L (00607)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)
JAN 19...	.46	.007	--	E.03	1.9	--	--	.64	1.4	.116	.136	.10	.319
MAR 21...	.19	.010	--	E.03	1.3	--	--	.65	1.1	.24	.112	.09	.273
MAY 16...	1.26	.064	--	E.04	2.5	--	--	.73	1.2	.38	.23	.25	.760
JUL 11...	--	E.005	.297	<.04	1.1	--	--	.40	.76	.042	.106	.09	.273
SEP 19...	.24	.007	.253	.05	1.1	.80	.82	.88	.85	.40	.38	.29	.883

Date	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
JAN 19...	1.8	7.8	1450	1480	218	1480
MAR 21...	3.2	4.6	--	--	65	242
MAY 16...	1.2	4.7	939	957	141	66
JUL 11...	3.4	1.6	313	318	44	7.0
SEP 19...	6.2	3.1	457	466	51	94

Table 6. Periodically collected water-quality properties and constituents at six sites in the San Bernard River, January 2001–August 2002—Continued

290935095455601 San Bernard River at FM 1301 nr East Columbia, TX—Continued

WATER-QUALITY DATA, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002

Date	Time	Instantaneous discharge, cfs (00061)	Specif. conductance, wat unf uS/cm 25 degC (00095)	pH, water, unfltrd field, std units (00400)	Temperature, water, deg C (00010)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	BOD, water, unfltrd 5 day, 20 degC mg/L (00310)	Fecal coliform, M-FC 0.7u MF col/ 100 mL (31625)	E coli, m-TEC MF, water, col/ 100 mL (31633)	Fecal streptococci KF MF, col/ 100 mL (31673)	Enterococci, m-E MF, water, col/ 100 mL (31649)
NOV													
14...	1118	30	662	7.7	19.8	760	6.6	73	.9	133	500	207	280
JAN													
30...	1055	112	745	7.6	18.4	761	8.0	85	.9	88	150	60	193
MAR													
14...	1450	31	966	7.8	19.8	757	8.0	89	2.0	116	48	133	--
MAY													
31...	1145	65	651	7.5	24.5	759	6.5	78	1.6	140	84	193	--
AUG													
29...	0850	162	308	7.4	27.7	765	5.2	66	2.7	88	680	--	353

Date	Nitrate water, fltrd, mg/L as N (00618)	Nitrite water, fltrd, mg/L as N (00613)	Nitrite + nitrate water unfltrd mg/L as N (00630)	Ammonia water, fltrd, mg/L as N (00608)	Total nitrogen, water, unfltrd mg/L (00600)	Ammonia + org-N, water, fltrd, mg/L as N (00623)	Ammonia + org-N, water, unfltrd mg/L as N (00625)	Phosphorus, water, unfltrd mg/L (00665)	Phosphorus, water, fltrd, mg/L (00666)	Orthophosphate, water, fltrd, mg/L as P (00671)	Orthophosphate, water, fltrd, mg/L (00660)	Chlorophyll a phytoplankton, fluoro, ug/L (70953)	Pheophytin a, phytoplankton, ug/L (62360)
NOV													
14...	--	<.008	<.10	<.04	.41	.28	.33	.119	.085	.07	.215	1.1	.5
JAN													
30...	--	<.008	.275	E.02	.67	.33	.40	.092	.056	.04	.129	2.9	1.1
MAR													
14...	--	<.008	.050	<.04	.43	.22	.38	.069	.030	.02	.055	12.3	4.3
MAY													
31...	1.81	.029	1.95	<.04	2.6	.57	.69	.130	.080	.06	.190	2.4	1.2
AUG													
29...	.51	.066	.620	E.04	1.7	.91	1.1	.34	.24	.21	.659	E.9	E1.1

Date	Biomass plankton, ash wgt mg/L (81353)	Biomass plankton, dry wgt mg/L (81354)	Suspended sediment concentration mg/L (80154)	Suspended sediment load, tons/d (80155)
NOV				
14...	291	297	16	1.3
JAN				
30...	341	347	32	9.7
MAR				
14...	540	552	28	2.3
MAY				
31...	378	387	120	21
AUG				
29...	E469	E481	30	13

Remark codes used in this report:
< -- Less than
E -- Estimated value

Table 8. Fish species collected in Dickinson Bayou, Texas Gulf Coastal Plain, 2000–2001

[Modified from Hogan (2002, table 3)]

	Sampling site				
	DCK01	DCK02	DCK03	DCK04	DCK05
Freshwater fish species					
Alligator gar					
Blue catfish					
Bluegill					
Brook silverside					
Channel catfish					
Common carp					
Freshwater drum					
Gizzard shad					
Grass carp					
Green sunfish					
Inland silverside					
Longnose gar					
Sailfin molly					
Smallmouth buffalo					
Spotted gar					
Threadfin shad					
Warmouth					
White crappie					
Brackish water fish species					
Atlantic croaker					
Bay anchovy					
Black drum					
Spotted seatrout					
Crevalle jack					
Gafftopsail catfish					
Gulf menhaden					
Hardhead catfish					
Ladyfish					
Pinfish					
Red drum					
Sand seatrout					
Sheepshead					
Sheepshead minnow					
Silver seatrout					
Southern flounder					
Spot					
Striped mullet					
Tarpon					

Table 9. Fish species collected in Armand Bayou, Texas Gulf Coastal Plain, 2000–2001

[Modified from Hogan (2002, table 2)]

	Sampling site				
	ARM01	ARM02	ARM03	HRSP01	HRSP02
Freshwater fish species					
Alligator gar					
Black crappie					
Blue catfish					
Bluegill					
Channel catfish					
Gizzard shad					
Green sunfish					
Largemouth bass					
Longear sunfish					
Longnose gar					
Sailfin molly					
Smallmouth buffalo					
Spotted gar					
Western mosquitofish					
White crappie					
Yellow bullhead					
Brackish water fish species					
Atlantic croaker					
Bay anchovy					
Black drum					
Gaftopsail catfish					
Gulf menhaden					
Hardhead catfish					
Ladyfish					
Lined sole					
Pinfish					
Red drum					
Sand seatrout					
Southern flounder					
Spot					
Striped mullet					

Table 10. Fish taxa and counts of individual fish collected in the San Bernard River, Texas Gulf Coastal Plain, 2000–2002

[Number of individuals per taxon shown for each site]

Group	Common name	Family	Scientific name	Sampling site						Total
				COUSH	WESTB	GUMTR	SANB01	SANB02	SANB03	
Gars		Lepisosteidae								
	Spotted gar		*Lepisosteus oculatus*	2	1	7	3	1	0	14
	Longnose gar		*Lepisosteus osseus*	0	0	0	0	0	1	1
Herrings		Clupeidae								
	Gizzard shad		*Dorosoma cepedianum*	0	2	3	0	0	0	5
Livebearers		Poeciliidae								
	Mosquito fish		*Gambusia* sp.	12	40	94	10	2	0	158
Suckers		Catostomidae								
	Smallmouth buffalo		*Ictiobus bubalus*	0	3	1	2	1	0	7
	River carpsucker		*Carpiodes carpio*	0	13	0	0	0	0	13
Bullhead catfish		Ictaluridae								
	Tadpole madtom		*Noturus gyrinus*	1	1	0	0	0	0	2
	Channel catfish		*Ictalurus punctatus*	0	1	18	0	0	1	20
	Flathead catfish		*Pylodictis olivaris*	0	2	0	1	0	0	3
	Yellow bullhead		*Ameiurus natalis*	0	0	3	0	0	0	3
Sunfishes		Centrarchidae								
	White crappie		*Poxomis annularis*	0	0	0	7	0	0	7
	Green sunfish		*Lepomis cyanellus*	2	21	81	4	0	0	108
	Redear sunfish		*Lepomis microlophus*	5	0	0	0	0	0	5
	Longear sunfish		*Lepomis megalotis*	16	4	7	9	2	4	42
	Bluegill		*Lepomis macrochirus*	25	1	10	15	0	0	51
	Warmouth		*Lepomis gulosus*	5	4	4	17	2	0	32
	Largemouth bass		*Micropterus salmoides*	0	0	0	1	0	0	1
	Redeye bass		*Micropterus coosae*	0	2	0	0	0	0	2
	Spotted bass		*Micropterus punctulatus*	2	0	0	0	1	0	3
Pirate perches		Aphredoderidae								
	Pirate perch		*Aphredoderus sayanus*	5	4	1	0	0	0	10
Drums		Sciaenidae								
	Freshwater drum		*Aplodinotus grunniens*	0	0	5	0	0	1	6
Perches		Percidae								
	Slough darter		*Etheostoma gracile*	0	1	2	0	0	0	3
	Bluntnose darter		*Etheostoma chlorosomum*	10	0	0	0	0	0	10
	Dusky darter		*Percina sciera*	0	0	0	0	1	0	1
Killifishes		Cyprinodontidae								
	Blackstripe topminnow		*Fundulus notatus*	8	0	1	0	0	1	10
Silversides		Atherinidae								
	Inland silverside		*Menidia beryllina*	0	0	1	0	0	0	1
Minnows		Cyprinidae								
	Blacktail shiner		*Cyprinella venusta*	0	1	2	0	6	1	10
	Common carp		*Cyprinus carpio*	0	2	4	0	0	0	6
	Mimic shiner		*Notropis volucellus*	0	0	0	3	0	0	3
	Red shiner		*Cyprinella lutrensis*	0	3	9	0	6	4	22
	Bullhead minnow		*Pimephales vigilax*	7	0	3	11	6	1	28
Pygmie sunfishes		Elassomatidae								
	Banded pygmy sunfish		*Elassoma zonatum*	0	0	0	2	1	0	3
Number of individuals				100	106	256	85	29	14	590
Number of taxa				13	18	19	13	11	8	

Table 11. Fish community data (metrics) for sites in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2002

Metric	Dickinson Bayou sampling site					Armand Bayou sampling site					San Bernard River sampling site					
	DCK01	DCK02	DCK03	DCK04	DCK05	ARM01	ARM02	ARM03	HRSP01	HRSP02	COUSH	WESTB	GUMTR	SANB01	SANB02	SANB03
Number of species	13	7	10	9	30	6	14	20	11	9	13	18	19	13	11	8
Menhinick's richness index	2.3	.90	1.3	1.4	1.0	.41	.63	.64	.62	.50	1.3	1.7	1.2	1.4	2.0	2.1
Shannon-Wiener diversity index	2.0	2.8	2.7	2.6	4.9	2.8	4.9	5.4	4.3	4.6	2.9	3.1	4.0	2.9	2.0	1.5
Number of darter species	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0
Number of sunfish species	4	0	0	0	0	3	3	1	2	0	6	5	4	5	4	1
Number of sucker species	1	0	0	0	0	0	1	0	0	1	0	2	1	1	1	0
Number of intolerant species[1]	0	0	0	1	6	0	0	2	0	0	1	1	0	0	1	0
Proportion[2] of green sunfish	.06	0	0	0	0	.02	0	0	0	0	.02	.20	.32	.05	0	0
Number of green sunfish	2	0	0	0	0	4	0	0	0	0	2	21	81	4	0	0
Proportion[2] of omnivores	.58	0.61	.56	.62	.60	.24	.92	.80	.78	.88	0	.20	.11	.02	.03	.07
Proportion[2] of insectivores	.09	0	.02	.05	.27	.74	.01	.03	0	0	.89	.52	.53	.59	.83	.86
Proportion[2] of piscivores	.33	.39	.41	.33	.13	.02	.07	.17	.22	0.12	.11	.28	.36	.39	.14	.07
Total number of individuals	33	61	63	39	859	218	495	963	313	102	100	106	256	85	29	14
Proportion[2] of hybrids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proportion[2] of external anomalies	0	0	0	0	.01	.01	.01	.08	0	.01	0	0	0	0	0	0

[1] Categorization of species intolerant to degraded water-quality conditions by Linam and Kleinsasser (1998).
[2] Proportion computed as ratio of number of individual fish in category to total number of fish collected at site.

Table 12. Benthic macroinvertebrate taxa and counts of individual taxa collected in the San Bernard River, Texas Gulf Coastal Plain, 2000–2002

[Number of individuals per taxon shown for each site]

Class	Order	Family	Subfamily	Genus or scientific name	Sampling site						
					COUSH	GUMTR	WESTB	SANB01	SANB02	SANB03	Total
Arachnida	Acari			*Acari*	2	0	0	0	8	1	11
		Hygrobatidae		*Hygrobatidae*	0	5	0	0	0	0	5
		Unionicolidae		*Unionicolidae*	6	0	0	0	0	0	6
		Sarcoptiformes		*Oribatei*	1	7	4	0	0	0	12
Bivalvia				*Bivalvia*	0	0	0	0	2	0	2
	Veneroidea	Sphaeriidae		*Eupera cubensis*	0	0	6	15	1	17	39
				Pisidium sp.	0	0	0	0	0	7	7
				Sphaeriidae	0	4	0	1	0	0	5
Crustacea	Amphipoda	Talitridae		*Hyalella azteca*	0	0	0	13	0	1	14
(Malacostraca)				*Hyalella* sp.	17	0	24	0	0	0	41
	Decapoda	Astacidae		*Procambarus* sp.	2	2	0	0	0	0	4
		Palaemonidae		*Palaemonetes kadiakensis*	13	4	11	20	12	15	75
				Palaemonidae	0	0	0	0	0	8	8
	Mysidacea	Mysidae		*Taphromysis louisianae*	0	0	0	9	0	0	9
Gastropoda	Basommatophora	Ancylidae		*Ancylidae*	2	0	0	6	1	1	10
				Ferrissia sp.	0	6	7	0	0	0	13
		Lymnaeidae		*Lymnaeidae*	2	0	0	0	0	0	2
		Planorbidae		*Planorbidae*	0	0	0	2	0	0	2
				Menetus dilatatus	0	21	12	0	0	0	33
		Physidae		*Physella* sp.	0	0	0	0	1	0	1
				Physidae	6	0	1	0	0	0	7
	Neotaenioglossa	Hydrobiidae		*Hydrobiidae*	0	0	1	18	22	44	85
Hirudinea	Gnathobdellida	Hirudinidae		*Hirudinea*	0	0	0	4	1	2	7
	Rhynchobdellida	Glossiphoniidae		*Glossiphoniidae*	0	0	1	0	0	0	1
Insecta	Coleoptera	Dytiscidae		*Liodessus* sp.	0	0	0	0	0	1	1
		Elmidae		*Dubiraphia* sp.	0	0	0	1	0	0	1
				Dubiraphia bivittata	0	0	2	0	0	0	2
				Heterelmis sp.	0	0	0	1	5	30	36
				Stenelmis sp.	1	0	19	1	2	0	23
		Gyrinidae		*Dineutus* sp.	2	0	0	2	0	0	4
				Gyretes sp.	0	0	1	0	0	3	4

Table 12. Benthic macroinvertebrate taxa and counts of individual taxa collected in the San Bernard River, Texas Gulf Coastal Plain, 2000–2002—Continued

Class	Order	Family	Subfamily	Genus or scientific name	Sampling site						
					COUSH	GUMTR	WESTB	SANB01	SANB02	SANB03	Total
Insecta—Cont.	Coleoptera—Cont.	Haliplidae		*Peltodytes* sp.	3	0	0	0	0	0	3
		Hydraenidae		*Hydraena* sp.	1	0	0	0	0	0	1
		Hydrophilidae		*Berosus* sp.	7	0	0	0	0	0	7
				Hydrochus sp.	0	0	0	0	0	1	1
		Noteridae		*Hydrocanthus* sp.	0	0	1	0	0	0	1
		Scirtidae		*Cyphon* sp.	0	2	7	3	1	1	14
	Diptera	Ceratopogonidae		*Atrichopogon* sp.	0	0	0	1	0	0	1
				Bezzia/Palpomyia sp.	4	0	0	0	0	0	4
				Ceratopogonidae	0	0	0	0	0	1	1
			Ceratopogoninae	*Ceratopogoninae*	0	0	0	2	13	20	35
				Labrundinia sp.	25	9	30	67	1	0	132
				Culicoides sp.	3	0	0	0	0	0	3
				Forcipomyia sp.	0	1	0	0	0	0	1
				Probezzia sp.	2	0	0	0	0	0	2
		Chaoboridae		*Chaoborus* sp.	1	0	0	0	0	0	1
		Chironomidae	Chironominae	*Chironomini*	0	1	0	0	0	2	3
				Cladotanytarsus sp.	10	1	0	0	8	1	20
				Cryptochironomus sp.	2	0	0	6	2	0	10
				Cryptotendipes sp.	1	0	0	1	0	0	2
				Dicrotendipes sp.	23	0	1	12	5	1	42
				Endochironomus sp.	76	0	0	0	0	0	76
				Glyptotendipes sp.	1	0	0	1	0	1	3
				Harnischia sp.	0	0	2	6	0	1	9
				Parachironomus sp.	0	1	0	13	4	5	23
				Paracladopelma sp.	0	0	0	0	0	1	1
				Paralauterborniella nigrohalteris	0	0	3	2	0	0	5
				Polypedilum halterale grp.	1	0	0	0	0	0	1
				Polypedilum illinoense gr	39	64	9	0	0	0	112
				Polypedilum scalaenum gr.	0	3	8	2	5	33	51
				Polypedilum sp.	0	0	0	24	1	2	27
				Pseudochironomus sp.	5	0	0	0	0	7	12
				Rheotanytarsus sp.	7	59	0	1	0	0	67
				Stenochironomus sp.	1	6	3	0	3	8	21
				Tanytarsus sp.	5	26	13	7	7	14	72
				Tribelos fuscicorne	0	0	0	4	0	17	21
				Tribelos sp.	2	0	4	0	0	0	6
			Orthocladiinae	*Corynoneura* sp.	0	1	3	0	1	4	9

Table 12. Benthic macroinvertebrate taxa and counts of individual taxa collected in the San Bernard River, Texas Gulf Coastal Plain, 2000–2002—Continued

Class	Order	Family	Subfamily	Genus or scientific name	Sampling site						
					COUSH	GUMTR	WESTB	SANB01	SANB02	SANB03	Total
Insecta—Cont.	Diptera—Cont.	Chironomidae	Orthocladiinae	*Cricotopus bicinctus* gr.	0	0	0	0	1	0	1
				Cricotopus sp.	0	0	0	0	2	0	2
				Nanocladius distinctus	0	0	0	0	1	0	1
				Nanocladius sp.	26	10	2	29	0	2	69
				Rheocricotopus robacki	0	0	0	1	10	0	11
				Rheocricotopus sp.	0	1	0	0	0	0	1
				Thienemanniella sp.	0	1	0	3	3	0	7
			Tanypodinae	*Ablabesmyia* sp.	22	12	14	74	5	26	153
				Clinotanypus sp.	0	0	0	0	0	2	2
				Larsia sp.	1	0	0	0	0	0	1
				Pentaneura sp.	0	0	0	2	17	0	19
				Procladius sp.	1	0	2	0	0	0	3
				Thienemannimyia gr. sp.	1	0	1	0	0	2	4
		Culicidae		*Anopheles* sp.	0	0	1	0	0	0	1
		Diptera		*Diptera*	0	0	0	2	0	0	2
		Phoridae		*Phoridae*	0	0	0	3	0	0	3
		Sciomyzidae		*Sciomyzidae*	0	0	0	4	0	0	4
		Simuliidae		*Simuliidae*	0	0	0	0	1	0	1
		Tabanidae		*Tabanidae*	0	0	0	1	0	0	1
	Ephemeroptera	Baetidae		*Baetidae*	0	0	0	0	1	1	2
				Baetis sp.	0	2	0	0	1	0	3
				Centroptilum sp.	3	0	0	0	0	0	3
				Fallceon quilleri	0	37	8	0	47	1	93
				Procloeon sp.	0	0	0	2	0	1	3
				Pseudocloeon sp.	0	0	0	6	0	0	6
		Caenidae		*Caenis diminuta*	16	0	0	0	0	0	16
				Caenis hilaris	19	0	0	0	0	0	19
				Caenis latipennis	0	0	38	9	0	0	47
				Caenis punctata	30	0	0	0	0	0	30
				Caenis sp.	0	1	0	5	24	1	31
		Heptageniidae		*Heptageniidae*	0	3	0	0	3	0	6
				Stenacron interpunctatum	0	0	30	11	1	0	42
				Stenacron sp.	0	0	0	0	0	1	1
		Isonychiidae		*Isonychia* sp.	0	0	0	0	9	1	10
		Leptophlebiidae		*Leptophlebiidae*	0	0	0	1	7	1	9
		Tricorythidae		*Tricorythodes* sp.	0	0	0	0	132	13	145
	Hemiptera	Corixidae		*Corixidae*	5	0	2	0	0	0	7

Table 12. Benthic macroinvertebrate taxa and counts of individual taxa collected in the San Bernard River, Texas Gulf Coastal Plain, 2000–2002—Continued

Class	Order	Family	Subfamily	Genus or scientific name	Sampling site						
					COUSH	GUMTR	WESTB	SANB01	SANB02	SANB03	Total
Insecta—Cont.	Hemiptera—Cont.	Nepidae		*Ranatra* sp.	0	0	0	0	1	1	2
	Odonata	Coenagrionidae		*Argia* sp.	1	16	3	8	1	1	30
				Coenagrion/Enallagma sp.	0	1	0	1	0	0	2
				Coenagrionidae	13	0	0	4	11	0	28
				Enallagma sp.	13	0	0	2	0	0	15
		Corduliidae		*Corduliidae*	0	0	0	1	0	0	1
		Gomphidae		*Stylurus* sp.	0	0	0	0	0	1	1
		Libellulidae		*Libellulidae*	3	0	0	0	0	0	3
	Neuroptera	Sisyridae		*Climacia* sp.	2	0	0	2	0	0	4
	Trichoptera	Hydropsychidae		*Cheumatopsyche* sp.	12	25	0	15	2	0	54
				Hydropsyche sp.	0	0	1	0	0	0	1
				Hydropsychidae	0	0	0	6	13	0	19
				Smicridea sp.	0	0	0	0	10	0	10
		Hydroptilidae		*Hydroptila* sp.	3	1	0	0	1	0	5
				Hydroptilidae	0	0	0	0	1	0	1
				Neotrichia sp.	0	0	1	3	3	2	9
				Oxyethira sp.	15	0	0	0	0	0	15
		Leptoceridae		*Nectopsyche* sp.	0	0	0	0	3	1	4
				Oecetis sp.	9	0	0	2	1	0	12
		Polycentropodidae		*Cernotina* sp.	2	0	0	0	0	0	2
				Cyrnellus sp.	0	0	0	28	1	8	37
				Neureclipsis sp.	0	0	0	0	0	1	1
				Polycentropus sp.	0	0	0	0	1	2	3
Nematoda (phylum)					0	0	0	0	0	1	1
Oligochaeta				*Oligochaeta*	19	17	46	18	21	47	168
	Branchiobdellida			*Branchiobdellida*	1	0	0	0	0	0	1
Ostracoda				*Ostracoda*	31	186	245	19	1	0	482
Number of individuals					521	536	567	507	442	367	2,940
Number of taxa					55	33	38	57	54	52	

Table 13. Benthic macroinvertebrate data (metrics) for sites in Dickinson Bayou, Armand Bayou, and the San Bernard River, Texas Gulf Coastal Plain, 2000–2001

[EPT, Ephemeroptera Plecoptera Trichoptera]

Metric	Dickinson Bayou sampling site					Armand Bayou sampling site					San Bernard River sampling site					
	DCK01	DCK02	DCK03	DCK04	DCK05	ARM01	ARM02	ARM03	HRSP01	HRSP02	COUSH	WESTB	GUMTR	SANB01	SANB02	SANB03
Number of taxa	35	4	25	15	22	34	25	20	26	24	53	38	31	57	54	52
EPT taxa richness	11	1	1	1	4	2	3	0	4	1	9	5	6	11	19	13
Percent EPT taxa	4.4	.48	.10	.22	.75	2.8	1.6	0	.70	.98	21	14	13	17	59	9.3
Percent Chironomidae	8.0	56	36	21	7.8	84	52	26	32	35	49	17	37	50	17	35
Percent Ephemeroptera	4.3	.48	.10	.22	.55	2.8	1.6	0	.56	.98	13	13	8	6.7	51	5.4
Percent Oligochaeta	23	16	.50	44	6.7	.47	1.6	28	24	41	3.8	8.1	3.2	3.6	4.7	13
Percent Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent Trichoptera	.16	0	0	0	.20	0	0	0	.13	0	8.1	.35	4.9	11	8.1	3.8
Percent filterers	19	0	3.1	13	22	3.7	2.1	19	1.3	2.7	4.7	3.5	22	11	5.9	8.2
Percent gatherers	58	67	58	31	5.4	85	28	16	58	50	28	60	50	26	63	32
Percent predators	10	33	2.2	31	19	2.8	34	13	22	12	19	9.7	9.4	34	14	16
Percent scrapers	4.3	0	9.0	1.6	2.8	6.6	0	.35	.58	.78	2.2	10	1.9	7.5	6.8	12
Percent shredders	25	56	20	4.9	3.9	.54	30	13	13	7.7	26	3.4	13	5.1	2.7	9.8
Number of filterer taxa	8	0	4	2	4	3	4	2	3	4	3	3	4	6	6	4
Number of gatherer taxa	16	2	7	5	3	9	11	5	12	7	13	12	13	17	17	22
Number of predator taxa	10	2	3	1	5	16	7	6	8	9	16	7	6	12	10	10
Number of scraper taxa	2	0	1	1	1	5	0	1	2	2	4	5	3	5	6	2
Number of shredder taxa	4	1	2	1	3	3	2	2	3	3	5	3	2	2	5	3
Shannon-Wiener diversity index	1.2	.50	.80	.98	1.0	.40	1.0	.88	.93	.87	1.4	1.0	1.0	1.4	1.3	1.4
Hilsenhoff's biotic index	4.4	2.4	2.3	2.0	.42	5.1	4.5	1.2	2.7	1.0	5.7	6.3	5.9	6.2	5.7	5.7
Margalef's richness index	5.1	1.4	3.2	3.4	3.3	4.1	4.1	3.0	4.0	3.1	5.8	4.6	3.2	6.8	6.9	8.6
Pielou's evenness index	.78	.83	.57	.70	.74	.25	.55	.56	.50	.50	.83	.65	.69	.82	.74	.80
Simpson's heterogeneity index	.90	.62	.75	.85	.88	.32	.83	.80	.78	.81	.95	.79	.84	.94	.88	.94

Table 14. Physical-habitat data for stream reaches at sites in the San Bernard River, Texas Gulf Coastal Plain, 2000–2001

[ft, feet; --, not available]

Datum	Sampling site					
	COUSH	WESTB	GUMTR	SANB01	SANB02	SANB03
Linear reach length (ft)	451	222	283	338	375	361
Curvilinear reach length (ft)	488	251	295	422	400	376
Sinuosity	1.08	1.13	1.04	1.25	1.07	1.04
Reach slope	.0252	.0081	.0001	.0004	.0007	.0009
Number of snags	--	--	--	8	3	10
Number of other obstructions	--	--	--	2	3	4
Number of stumps	--	--	--	0	1	0
Number of undercut banks	--	--	--	0	0	0
Number of bars	--	--	--	0	0	0
Mean right bank slope	.36	.27	.24	.20	.17	.21
Mean left bank slope	.14	.36	.27	.22	.20	.32
Mean bank slope	.25	.32	.26	.21	.19	.27
Mean channel width (ft)	65.9	68.0	44.5	73.4	107	108
Mean right bank height (ft)	9.35	11.5	8.27	6.56	15	18.6
Mean left bank height (ft)	5.99	8.50	7.29	6.88	14	19.9
Mean bank height/channel width ratio	.32	.47	.48	.10	.14	.18
Mean wetted channel width (ft)	27.0	22.2	17.0	29.8	51.1	51.9
Mean depth (ft)	3.16	2.68	1.38	3.18	4.42	4.91